ENGINEERING NEWS-RECORD

A Consolidation of Engineering News, Engineering Record, The Sanitary Engineer, and The Contractor

F. E. SCHMITT, *Editor*

Editorial Staff
New York
V. T. BOUGHTON
Managing Editor
M. N. BAKER
C. S. HILL
W. G. BOWMAN
H. W. RICHARDSON
R. B. GARRABRANT

Editorial Staff
Chicago
E. E. R. TRATMAN
W. W. DE BERARD
San Francisco
N. A. BOWERS

WILLARD CHEVALIER
Publishing Director

Contents for December 19, 1929

VOLUME 103, NUMBER 25

Copyright, 1929, by McGraw-Hill Publishing Company, Inc.

Calderwood High Arch Dam Designed With Deep Cushion Pool to Receive Overflow 954

GRAVITY DAM 40 ft. high forms pool below 230-ft. arch on power project in Tennessee.

Novel Sinking Equipment for Steel Cylinder Foundations 959

THREESCORE CYLINDERS sunk in deep water by riveting sections on top and lowering with gallows frame.

New Knowledge of Roads 961

HIGHWAY RESEARCH BOARD meeting devoted mainly to outlining questions which need to be studied.

Gas-Welding Shop Fabrication of a 300-Ton Mill Building 964

EQUIPMENT, layout and labor problems solved in fitting a structural steel fabricating shop for welding. BY H. M. PRIEST AND H. H. MOSS

Eight Years of Litigation Over Seattle Bascule Bridges 968

NON-INFRINGING DESIGN is developed when city is harried by suits for infringement of patent.

Motors and Control for Movable Bridges 970

BASIC FACTORS to be considered in selecting electrical equipment for bascule, swing and vertical lift bridges. BY H. W. PITTENGER

Incinerator Converts Paris Refuse Into Electric Power and Brick 974

GARBAGE and refuse burned in 1,100-ton plant which raises steam and produces electricity for works purposes. BY MAURICE BRICARD

Editorial 951

News of the Week 983

Construction Equipment and Materials 989

Monthly Review of Engineering Literature 978

McGRAW-HILL PUBLISHING COMPANY, INC., Tenth Ave. at 36th St., New York, N. Y.

CABLE ADDRESS: "MACHINIST, N. Y."

JAMES H. MCGRAW, *Chairman of the Board*
MALCOLM MUIR, *President*
JAMES H. MCGRAW, JR., *Vice-Pres. and Treas.*
EDWARD J. MEHREN, *Vice-President*
MASON BRITTON, *Vice-President*
EDGAR KOBAK, *Vice-President*
HAROLD W. MCGRAW, *Vice-President*
H. C. PARMELEE, *Editorial Director*
C. H. THOMPSON, *Secretary*

Member A.B.C.
Member A.B.P.

NEW YORK, *District Office, 285 Madison Avenue*
WASHINGTON, *National Press Building*
CHICAGO, *520 N. Michigan Avenue*
GREENVILLE, S. C., *1301 Woodside Bldg.*
BOSTON, *1427 Statler Building*
PHILADELPHIA, *1600 Arch Street*
DETROIT, *j-257 General Motors Bldg.*
CLEVELAND, *Guardian Building*
ST. LOUIS, *Bell Telephone Building*
SAN FRANCISCO, *883 Mission Street*
LOS ANGELES, *632 Chamber of Commerce Building*
LONDON, *6 Bouverie Street, London, E. C. 4*

NUMBER OF COPIES PRINTED THIS ISSUE 31,887

"Listen to this"----

"LISTEN TO THIS," said Dan over the lunch box. "When my street car got close to the tunnel, I spotted two kids on the trestle of the steam railroad watching the traffic below. All of a sudden along comes the steam train swingin' around the curve at a fast clip, and the young 'uns couldn't see it. Yell! yes, plenty and ringin' the gong like the devil, but nary a bit of good did it do until—well they started to run. One got clear, but Guy tripped on somethin' . . . . fell . . . . *sprawled on the tracks*. The locomotive hit him . . . . knocked him between the rails. The whole Works rolls over him. Just as the third coach was going over, Guy sort of raised up and whack! something hit his head. We all thinks it's the end. I runs over and grabs him. Took his sweater off and puts it under his head. His hip was dislocated so I sets it again. The kid wasn't breathing. I rolled him over on his face and gave him prone-pressure treatment. Didn't have much luck at first but finally he opened his eyes. As soon as I stopped he went cold, so I began again as if he was my own kid. Pretty soon he came to—this time to stay."

—A Motorman's Story

This is one incident from many in the files of Stone & Webster Companies. Stone & Webster men are trained in First Aid. Their prompt and level-headed action has saved many lives.

The Coffin Medal, the highest award in the electrical industry, has been won four times in eight years by companies under Stone & Webster executive management.

The Insull Medal has, seven times, been awarded to Stone & Webster men; the McCarter Medal, three times; the President's Medal of the National Safety Council twice; the Liberty Mutual Insurance Company Medal, once. Two companies have won the Anthony N. Brady Memorial Medal for Outstanding Accident Prevention and Health Work on Electric Railways. Another is local representative of the National Red Cross.

STONE & WEBSTER

INCORPORATED

OPERATE FINANCE BUILD

ENGINEERING NEWS-RECORD

A McGRAW-HILL PUBLICATION — ESTABLISHED 1874

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

F. E. SCHMITT, *Editor*

Volume 103 NEW YORK, DECEMBER 19, 1929 Number 25

The Season's Greetings

NO OTHER day carries with it that sense of human fellowship which forms such an essential part of the spirit of Christmas. Mellowed by centuries of observance, the day brings to the surface those qualities of kindness and graciousness which at other times are submerged in the confusion and complexity of everyday affairs. Perhaps the time will come when this spirit will be spread throughout the year; meanwhile each of us is privileged, for a brief period, to forget ordinary care in order to recognize once more the essential *ucering News-Record* offer its friends, the readers of these pages, sincere and hearty good wishes for the holiday season.

Noteworthy Structures

SELDOM are so many notable engineering details found in any one hydro-electric development as in the great plant now under construction on the Little Tennessee River which is described in this issue. Both in the character of the structures involved and in the methods employed to obtain a check upon the design theories the undertaking will attract wide interest in engineering circles. The dam iself is a high thin arch with provision for discharge of floodwaters by direct overfall into a cushion pool formed by a low dam built some distance downstream. As a further protection against erosion at the toe of the main dam bucket deflectors are built across the stream bottom below the dam to receive the overfall during periods of flood flow. Another striking feature of the project is the differential surge chamber blasted out of solid rock near the lower end of the pressure tunnel which serves the power house. There are few if any others like it except in a project under construction in Chosen described in our issue of Oct. 31, 1929, p. 678. The whole project is a splendid example of able engineering in developing structures to take advantage of the peculiarities of the site. Also it shows how easily theories may be checked in actual practice by the expenditure of a little additional time and money, provided those in charge of the pursestrings are far sighted enough to see that in the long run they will gain by the small added expense involved in making provision for such tests during the period of design and construction.

A Far-Reaching Decision

JUDGE DAWKINS has decided at Monroe, La., that the Mississippi floodway lands may not be subjected to the risk of destructive flood discharges unless the owners are compensated for their loss. It is a common-sense decision. The outcome is surprising only in view of the fact that a former Chief of Engineers deliberately planned to utilize the land for a flood channel without compensation, that a former President issued an order to this very end, and that the government witnesses at the trial in Monroe strained their ingenuity to show that destructive flooding would not occur, until under cross-examination they admitted the contrary. The decision having been made, it is time to forget the past and to look to the future. Manifestly, the whole economic basis of the present diversion-channel project of the Jadwin plan is destroyed, and the figures come back to an approximation of those which the Mississippi River Commission set up something more than two years ago. Mississippi River flood control becomes no longer a $294,000,000 or even a $325,000,000 undertaking, but one measured in terms of many additional hundreds of millions and quite probably approaching a billion dollars. In these premises it is time to stop and carefully re-scrutinize the entire problem at issue. Calm and sober-minded study is now readily possible. The army engineers have spent two years in intensive work and investigation along the river. A new administration is in charge and is able to take up the problem free from hampering animosities. In the meantime there is no need to check construction, for the work along the main river can well absorb all available energies; but the aspect of the project as a whole may be profoundly modified by the effect of the present decision.

Marketing Natural Gas

ONE new problem that has recently appeared on the horizon gives promise of developing into a task of major importance. We refer to the necessity for constructing pipe lines to market the vast stores of natural gas recently discovered in Texas, Louisiana, Arkansas and California. Within the past two years approximately 4,000 miles of new main-line pipe have been installed, and pipe manufacturers report capacity operations to supply the several thousands of miles of line projected for 1930. Although the natural gas industry has been in existence many years and boasts some 75,000 miles of pipe 14 to 24 inches in diameter, most of the natural gas in the past has found a market not many miles from the gas field. In the present era of natural gas development several new factors are present. Deep drilling for oil has produced huge volumes of high-heating-value gas. High-pressure long-distance transmission has been developed to a degree of commercial practicability. Latterly, various state conservation measures, notably in California, prohibiting unreasonable waste of natural gas, are causing many oil companies to seek and even to develop a market for this valuable byproduct. The inauguration of improved methods of welding in pipe manufacture has also played a notable part. As a result, these newer pipe lines are reaching to far off industrial centers—Denver, San Francisco, Kansas City, St. Louis, Birmingham, Atlanta—whose distances from the gas field vary from 350 to 900 miles. Only recently a new line has been planned in California to carry gas to Seattle, a distance of 1,000

miles from the Kettleman Hills field some 500 miles south of San Francisco. Obviously, design and construction of this vast mileage of pipe line, utilizing pipe up to 24 inches in diameter, is an engineering task of first magnitude. The increasing supply of natural gas by virtue of more widespread conservation measures and its adoption for heating and manufacturing processes in industrial communities promises to increase rather than diminish activity in this new field of civil engineering.

The Influence of Great Projects

THE fact that most great engineering projects have a profound influence on the progress of the art would seem to be self-evident. Yet there are those who claim from time to time that accounts of the design and construction of such projects are of interest only to a limited few. At the present time the Fort Lee Hudson River suspension bridge in New York City is by far the greatest bridge project actually under construction. Very little of the prodigious amount of development work, of design studies and of erection plans involved in this structure has been reported, so that the total effect which it will have on the course of the civil engineering can scarcely be approximated now. Yet because of this structure we know that the open cofferdam is a competitor of the pneumatic caisson in river and harbor foundations up to 75 ft. in depth and 100 ft. square in plan; we have seen tests demonstrate that the action of large built-up structural steel column sections under load corresponds closely to our accepted design theories; we have results available showing the relative strength of silicon and carbon-manganese structural steels; we have learned that cold-drawn wire can be made with an ultimate strength of nearly 240,000 lb. and a yield point of 185,000 lb.; and we shall soon know what effect concrete incasement has on the carrying capacity of structural steel columns. Although hardly half completed, the Hudson River bridge has already influenced the design of two structures now being built; for the long-span rope-strand suspension systems of the Grand'Mere bridge in Quebec and the St. Johns bridge in Portland, Ore., are possible only by virtue of the studies made on footwalk cables for the Fort Lee structure. As time goes on and other results of research and accomplishment on this great structure are made available, our present knowledge will be vastly augmented and enriched. Engineering structures, large and small, will reap the benefit. It has ever been thus with great projects. As much as any one thing in civil engineering history, they have helped to push back the borders of the impossible.

The Chicago Tax Muddle

IT IS budget time in Chicago. City, county, school board and other tax officials are scurrying around holding midnight and Sunday meetings. It is a great show of last-minute activity—last-minute because by law it is necessary to have on file a budget for corporate funds, with the total amount set below anticipated tax receipts, before money can legally be borrowed with which to pay current salaries.

The reader doubtless knows that the Chicago treasury is chronically empty in December. But this year the normal condition is aggravated by two serious happenings. First, money has not been collected for 1928 taxes because of assessment difficulties, leading to a reassessment now in progress. Second, the reassessment valuations so far as determined are greatly lowered from the previous valuations, so that instead of the anticipated increase in revenue there is a material decrease. An added difficulty is a political situation wherein confidence in the administration has been lost to such an extent that bond issues are voted down indiscriminately, even when they affect meritorious projects or are meant to provide for legal judgments carrying high interest rates that must be met from current taxes. The voters express their disapproval in this form rather than by electing officials in whom they have confidence.

The whole scheme of taxing, assessing and financing is so complicated that the ordinary voter never succeeds in understanding the procedure that must be followed by the fiscal authorities. Recently, however, there has been published a comprehensive report by a county-appointed joint commission on real estate valuation, headed by George O. Fairweather, a lawyer, and including such men as John W. Alvord, consulting engineer, and Walter Dill Scott, president of Northwestern University. This exhaustive report indicates the cause-and-effect relation between faulty assessments and faulty financing. It indicates the essential part which a straightforward, simple assessment service must play in any definite plan for measures that will pull the local governments out of red ink and keep them solvent.

It outlines concurrent relief measures as follows: (1) a sound assessment service, which is basic to any plan for permanent financial relief; (2) a definite temporary borrowing power which fixes the limit for mortgaging future income; (3) a definite budget law which controls expenditures in relation to revenue; (4) a funding of existing departments which frankly and economically faces the sad facts of present deficits as they are, and prepares the way, not for repetition but for orderly and controlled public finance programs. As the report states, any relief plan which omits any one of these items is temporizing and is quite likely not to receive public approval.

In other words, if the prodigal is to have the past forgiven, assurance must be obtained that future policy will be changed from one of "spend it now and get it later" to one of "get it first." Temporary borrowing laws must be revised. Floating debts must be funded. The assessment organization must be simplified. In New York, Philadelphia, Detroit, Cleveland, Cincinnati, and all cities outside of Illinois, appropriation and temporary borrowing follow after assessment. In 1927 Chicago appropriated and borrowed fifteen months prior to the assessment! The financial system in Cook County has broken down because this lapse of time resulted in an unreasonable, unsound and uncontrollable borrowing policy, and because politics has paralyzed the assessment organization to such an extent that legal limits as to time have been ignored.

Figures for all the governmental agencies in Cook County have not yet been presented, but for the city of Chicago alone the treasurer will start 1930 with outstanding obligations of $92,825,000 incurred in anticipation of two tax levies (1928 and 1929) from which $75,000,000 will eventually be received. Cash for 1930 operation will be provided by collections during the year of $16,000,000 fees and miscellaneous revenue and loans on $38,500,000 anticipated taxes for 1930 (not collectible until 1931). Of the possible $54,500,000 anticipated, nearly $18,000,000 is needed to liquidate the obligations incurred above the amount that will be received from

the 1928-1929 tax levies. Expenditure of $54,500,000, the figure down to which the worried budget makers are striving to bring their present totals, will be $6,000,000 below 1929 expenditures, leaving, if the analysis has been followed, $18,000,000 in unpaid bills or illegal loans on Dec. 31, 1930. The above refers to the city of Chicago. Like predicaments and deficits face the county, the school board and other tax-levying bodies.

No mention has yet been made of the antics and gestures of the budget makers, who sit around the table and trim out of departmental payrolls rather carefully at first a few thousand dollars of non-essential items until publicity is needed. Then come the blows at the fire and police departments and the public works. The latter is not able to make propaganda of safety or public calamity, and therefore all too often must endure its cuts while the fire and police get back much of their curtailment. Both county and city have efficiency staffs, manned by engineers who are supposed to help the officials revise the departmental budgets, but their recommendations all too often go down before the barrage of political expediency or the effectiveness with which departmental heads present their pleas to retain the amounts which they asked for originally.

Meanwhile on the outside are the critics who condemn all spending as unrighteous and grafting in nature, whereas the politicians are in many cases the victims of an iniquitous financial system, the coils of which were shaped long before their advent on the scene. The report of the Fairweather committee with the definite recommendation of sound financial policy therefore comes at an opportune time. Under the spur of dire necessity there now seems to be some chance for a real setting in order of Chicago's antiquated, unsound, uneconomical and graft-producing fiscal procedure.

Welding Fabrication

WHEN and if welding enters the structural field as a competitor of riveting on a tonnage basis, fabricating facilities as we now know them must undergo a radical change. There is no present prospect that riveting will be entirely displaced, and such changes as may come will therefore be represented by the establishment of special welding shops in fabricating plants. A valuable indication of basic requirements for such a welding shop is given in an article in this issue describing a shop which has been revamped for welding and in which several of the most important of our present welded buildings have been fabricated. The job in question is the gas-welded building at Niagara Falls, N. Y., but the essential requirements will apply equally well to arc-welded structures.

The average shop superintendent will attune himself to the physical revamping with comparative ease. The principle of straight-line movement of material to the final assembly into shipping pieces is common to both riveted and welded fabrication and is familiar enough. Less handling of heavy pieces and more work on small details than in riveted work will characterize welded fabrication. For the Niagara Falls building, a column station, a truss station and a detail station were each placed in special bays in the shop building. In general, the character of the structure to be welded will determine such divisions of the work.

Personnel reorganization to suit the new processes is likely to be the more unfamiliar and therefore more difficult part of the readjustment to production welding. Closer check must be kept on ability and sustained excellence of work. Periodic tests of individual workmanship must be made. The workmen must be imbued with a desire to turn out good work, a necessity that is not so compelling with riveted construction. Personnel work will be a major task in the welding shop of the future.

That fabricators are planning for welding there can be little doubt. Few of them, however, have had an opportunity to get down to details. The article in this issue, therefore, should prove valuable for the insight it gives into a new field. Many of the examples given there can be turned to good use when welding fabrication attains a tonnage significance.

Road Research—The Future

BUILDING the country's road system remains the work of the future. Only a small part of the task has been done; more than two million miles are still in the mud and barely a hundred thousand miles have been paved. Yet so much has flowed from even this work, and so much more promises to come from its extension, that the intensive prosecution of the enterprise is assured. Large and difficult work lies ahead, therefore.

Engineering ability of the highest type, supported by scientific study, is necessary if this coming work is to be fully successful. The critical new element is research. As yet the art of road building rests on an empirical basis, in spite of some important investigations; the road work of the next dozen years ought to have surer grounding. Each day with its extending road mileage and growing traffic brings more difficult questions. Doubts arise as to whether the roads so far built are suitable and adequate. When we see that some of the roads built only half a dozen years ago are being reconstructed, we inevitably ask for better foreknowledge. It is the part of research to provide that knowledge. In short, the future of road construction depends on research.

The situation presents a brilliant opportunity to all who are engaged in road research, and particularly to their centralizing group, the Board of Highway Research. The board may well feel inspired by the possibilities which lie before it and the certainty that wise and vigorous effort will bring them to realization. But there must be that effort, derived from new life and new purpose.

In its eight years of existence the board has done little—hardly more than restate and review the results of work done on the initiative of others. It is now mature, its apprentice years are over, and ripened achievement is expected. With road affairs at a turning point, the board itself enters a new stage of its existence. It bears henceforth a definite share of the responsibility for efficient road development. Except as it discharges that obligation effectively it cannot long survive.

The future of the board is in the hands of the men who shape its policies. Recognizing the new demands which the present day imposes, they must also realize that new vigor, new aim and wisdom are requisite if the organization is to meet these demands. They hold a trusteeship for the road-building art, not only of this country but of the rest of the world, which looks to our more advanced practices as a model. Their purpose and wisdom in guiding road reseach will determine coming progress.

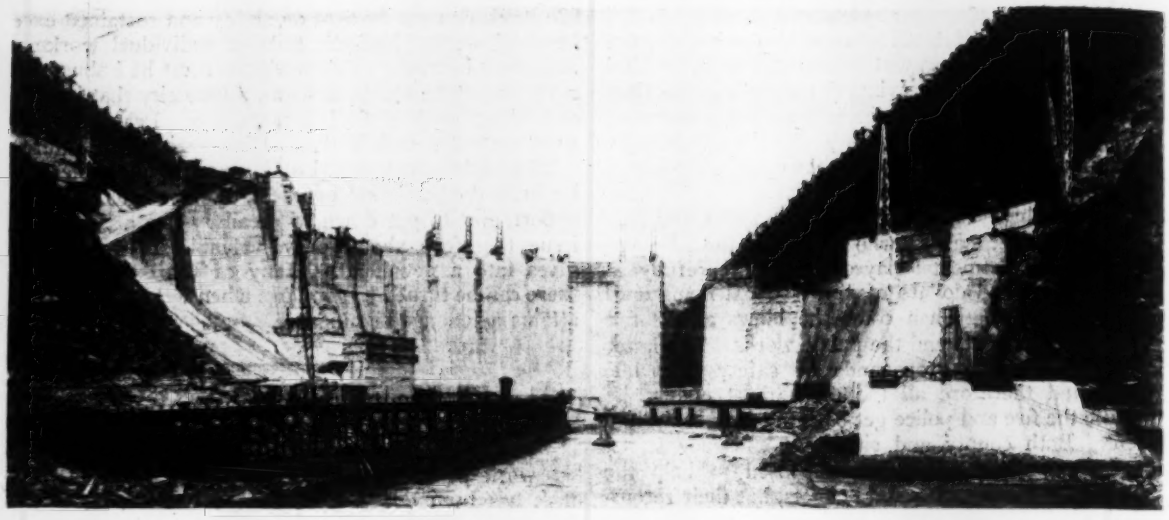


Fig. 1—View of Calderwood Dam Under Construction

Calderwood High Arch Dam Designed With Deep Cushion Pool to Receive Overflow

Gravity Dam 40 Ft. High Forms Pool Below 230-Ft. Arch on Power Project in Tennessee—Deflections of Arch Under Load to Be Measured—Differential Surge Chamber in Solid Rock

A THIN-SECTION concrete arch overfall dam, 230 ft. high, with its downstream toe protected by a deep cushion pool formed by a 40-ft. gravity dam a short distance downstream, is being built at Calderwood, Tenn., 45 miles south of Knoxville, as the third unit of the hydro-electric development of the Little Tennessee River by the Aluminum Company of America. Other interesting features of this dam are the character of the concrete used (*Engineering News-Record*, Oct. 24, 1929, p. 640) and the elaborate preparations being made to determine the arch deflections as the reservoir fills. Besides the main arch and cushion pool dams, the Calderwood project consists of a pressure tunnel 26 ft. wide and 24 ft. high, inside of lining, 2,400 ft. long; an 18-ft. diameter surge shaft and a 42x30-ft. differential surge chamber 124 ft. long dug out of solid rock; and a generating plant containing three 56,000-hp. reaction-type turbines operating under a 213-ft. head. The development is located on a 180 deg. bend in the river where 32 ft. of additional head could be gained by a tunnel cutting across the bend.

General Development—The Calderwood project is the third to be built on the Little Tennessee River and tributaries to supply power for the electrolytic reduction of aluminum at the Aluminum company's plant at Alcoa, near Maryville, Tenn. The Cheoah project, the first to be built, was completed in 1918. It is located on Little Tennessee River just above its junction with the Cheoah River. The Calderwood reservoir, 10 miles long, will reach to the Cheoah dam.

The second project to be built, the Santeetlah dam, is located on the Cheoah River 8 miles above its junction with the Little Tennessee. It was completed in 1928. The power house for this project is located on the shore of the Cheoah reservoir at the end of an 11-ft. pipe line and tunnel conduit 5 miles long.

Design of Calderwood Dam—The main dam is a thin-section arch 230 ft. from lowest foundation (El. 750) to top of piers (El. 980), with a downstream radius at the crest of 312.5 ft. Plan and sections are shown in Fig. 3. From the crest at El. 945 down to the 900-ft. elevation, the rings are of constant radius as well as of a constant radial thickness of 25 ft. Below this elevation the radius rapidly decreases to a minimum at the base, and the crown thickness increases. In addition, each arch ring

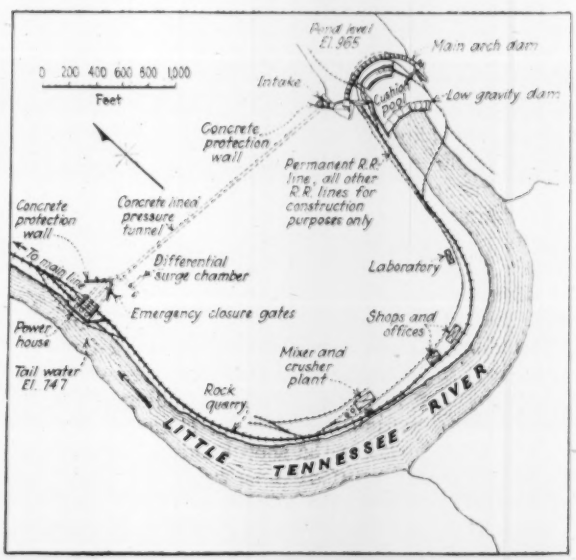


FIG. 2—MAP OF CALDERWOOD DEVELOPMENT

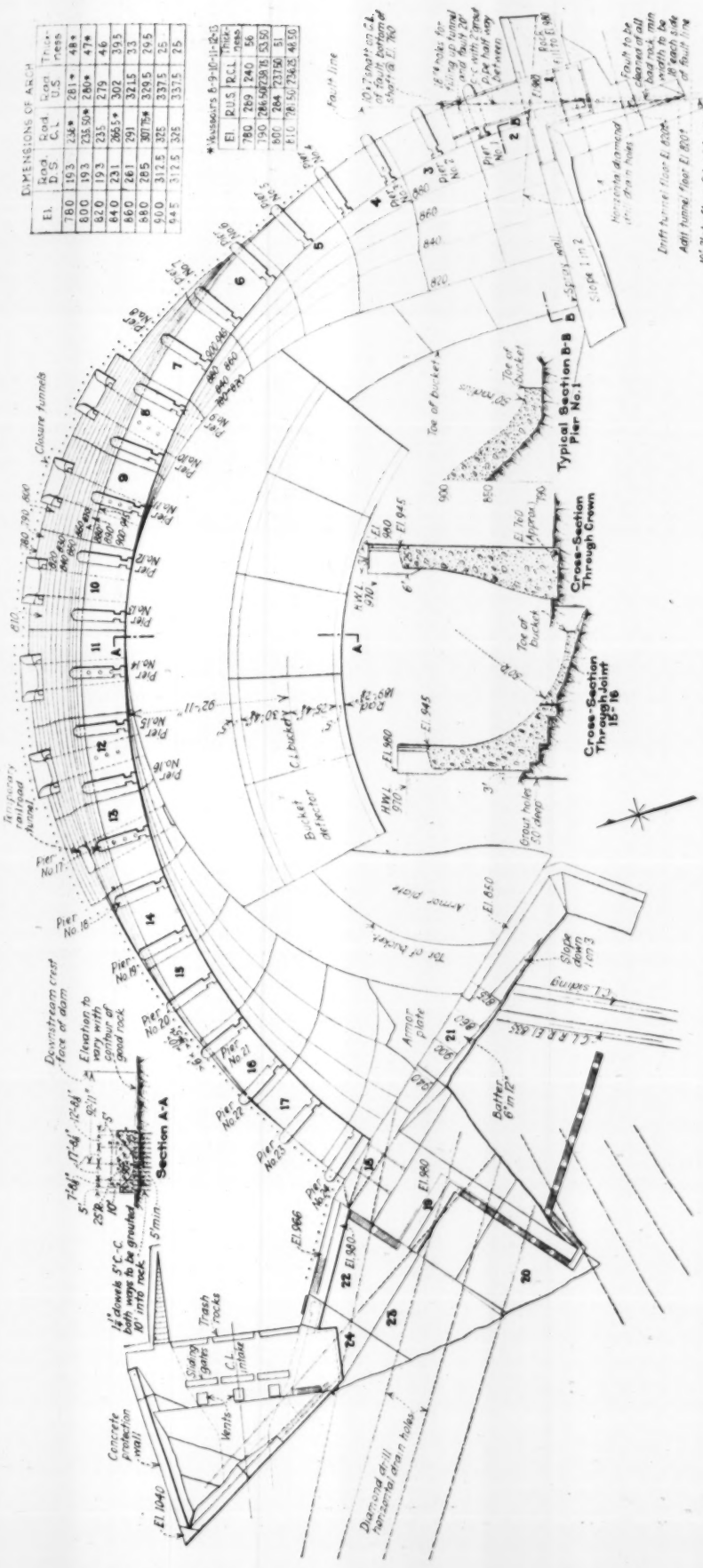


FIG. 3—PLAN AND SECTIONS OF MAIN ARCH DAM

varies in radial thickness from a minimum at the crown to a maximum at the abutments. The upper portion of the dam supports 24 Stoney type gates, 25 ft. long and 20 ft. high, which not only control the pond level but also provide spillway area sufficient to pass a flood of 200,000 sec.-ft., double that of any recorded on this stream, without raising the water level above El. 965. The gates are located at the downstream edge of the crest for two reasons: (1) in order that the weight of the water on the crest may add stability to the structure by counterbalancing the twisting moment in the crest arch ring caused by the overturning moment of the piers, (2) in order that the sheet of falling water may be deflected as far as possible from the base of the dam. They will be handled by two electric gantry cranes operating on tracks placed on top of the piers. A gasoline generator stand-by unit is provided for emergency use. Automatic grappling hooks will be used for raising the gates, eliminating the usual hand hooks.

For construction purposes the dam is divided into radial blocks. The joints between the blocks are closed off at the upstream and downstream faces by metal strips and will be grouted through a system of grooves placed in the joints. During construction the river is carried through five closure tunnels 15 ft. wide and 20 ft. high, to be closed by sliding steel gates on the upstream side. After closure the tunnels will be filled with concrete through 18-in. pipes run vertically from the tunnels to the top of the dam. To keep open a railroad running from Calderwood to the Cheoah dam a tunnel runs through block 13 to be filled in the same manner as the closure tunnels.

Because the existing railroad extending along the river from Chilhowee past Calderwood to the Cheoah dam will be blocked by Calderwood dam, a barge and motor boat service is to be installed on the lake above the dam to provide access to the plants for repair parts and supplies. A permanent derrick will transfer loads over the dam. At Calderwood dam an elevator

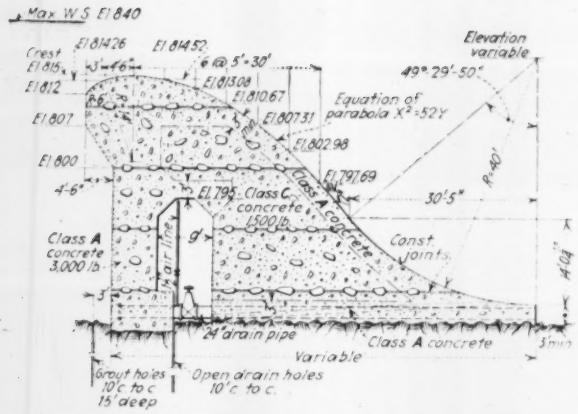


FIG. 4—CROSS-SECTION OF CUSHION POOL DAM

to convey passengers will be operated up the face of the abutment.

Arch Deflection Tests—For probably the first time in engineering history (excepting the Stevenson Creek dam experiments), preparations are being made to measure the deflection of a full-sized arch dam under various loads. On the downstream face 105 hooks are being buried in the concrete as construction progresses, protected at the surface by shallow recesses, located as shown in Fig. 6. All measurements will be made by a tape from a heavy concrete pier built about 300 ft. below the arch on its symmetrical axis. A revolving frame on the pier, fitted with ball-bearing sheaves, will carry the tape, which will be held at a constant tension by a counterweight. Tape readings will be made from a stamped mark on the frame. Measurements will be made to all points before the sluice gates are closed. As the reservoir starts to fill, continuous readings will be taken, air and water temperatures being recorded automatically.

In addition to the deflection measurements strain-gage readings will be taken simultaneously on 40 rosettes buried in the concrete on the downstream face, giving readings in vertical, horizontal and two diagonal positions with a 10-in. Whittemore strain gage. Ten automatic electric thermocouples are being buried in the concrete at various depths to obtain data on temperatures of concrete setting.

It is hoped that the results of these test measurements, when compared with theoretical stresses and deflections computed in accordance with the several theories advanced as the action of stresses in arch dams, will establish some criteria on which the design of future dams may be based. In the design of the Calderwood dam, each arch ring was made of sufficient strength to take the full water load in arch action without relief due to cantilever, beam or gravity action. Stresses were computed in accordance with theory of elastic work, neglecting the elastic work due to shear, by a rapid method of design developed by the company's engineers. These stresses were checked with a remarkable degree of accuracy by the voussoir method developed by F. W. Hanna, consulting engineer.

Excavation and Grouting—About 400,000 cu.yd. of excavation was required, much of the yardage coming from stripping the overburden for the right abutment. Removing this overburden revealed a smooth, tight rock ledge sloping upward at 60 deg. On the left abutment

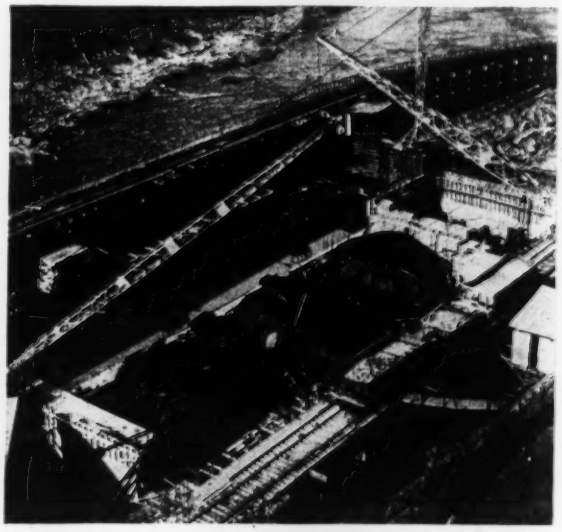


FIG. 5—SCROLL CASES IN POWER HOUSE BEFORE CONCRETING

excavation a very old narrow geological fault containing some gouge was found running into the mountain almost parallel with the arch thrust (Fig. 3). The fault is being cleaned out entirely and filled with concrete. The dam rests on hard tight arkose, providing an excellent foundation. Grout holes 50 ft. deep were drilled 3 ft. above the upstream toe on 10-ft. centers, and were grouted to refusal. Holes of equal depth were then

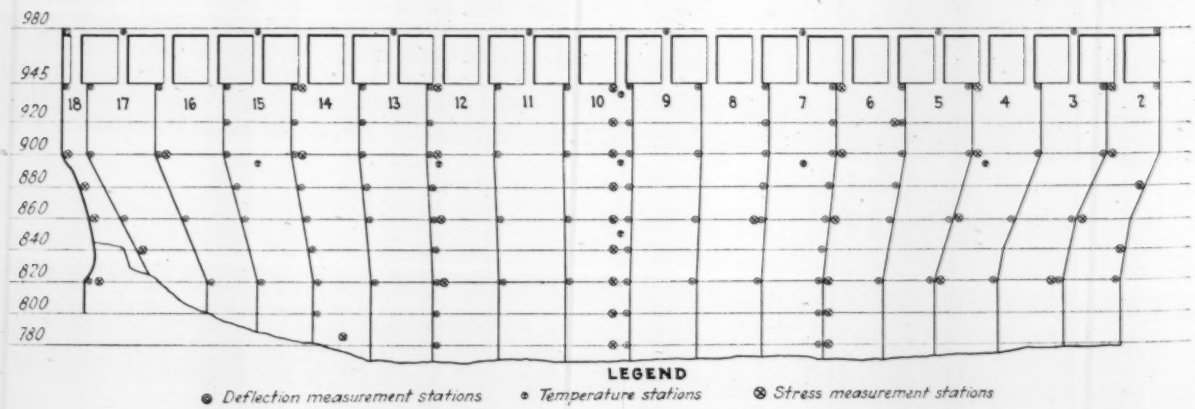


FIG. 6—DEVELOPED DOWNSTREAM FACE OF ARCH DAM SHOWING LOCATION OF DEFLECTION, STRESS AND TEMPERATURE POINTS

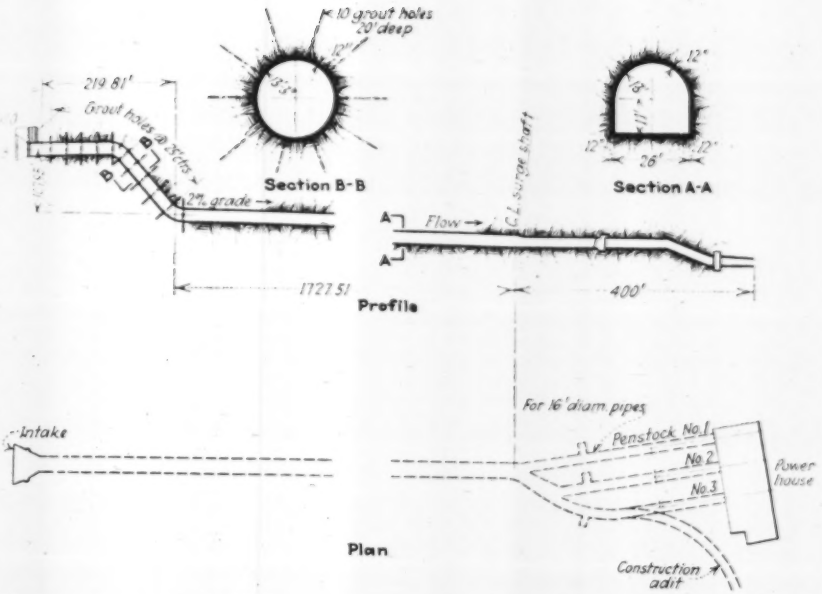


FIG. 7—PLAN, PROFILE AND SECTIONS OF TUNNEL AND PENSTOCKS

drilled between the original holes and grouted. The small amount of grout taken by the second set of holes proved the effectiveness of the first set.

Behind this grout curtain on each abutment, open horizontal diamond drill holes are being drilled into the rock under the concrete to relieve any pressure that might build up between the rock layers or on the exterior of the tunnel lining.

Concrete Armor and Jet Deflectors—In addition to the protection offered by the cushion pool, the downstream toe of the main dam is protected by reinforced-concrete armor of 3-ft. minimum thickness and concrete bucket deflectors, placed to deflect the main overflow current, as detailed in Fig. 3. The center line of the deflectors for the center portion of the dam is curved concentric with and 92 ft. 11 in. out from the downstream lip of the crest.

Cushion Pool Dam—The gravity ogee section dam forming the cushion pool is located about 400 ft. downstream from the center of the main dam. It is not curved in plan, but is broken into three tangents, with a total crest length of 300 ft. The crest of this dam is at El. 815. The left end of the dam abuts against the side of the gorge, but the right end meets a deflecting wall coming from the main dam, leaving space for a railroad track to the arch between the wall and mountain side. Fig. 4 shows a cross-section of this dam, giving in detail the curve of the overflow. Three 24-in. pipes, controlled by valves located in an inspection gallery which extends the full length of the dam, provide means to drain the pool when necessary. Plumbstones are placed in the horizontal construction joints to resist shear in the structure.

The cushion pool will have a minimum depth of 35 ft. and a maximum of 65 ft. during full flood. Grout holes were placed 3 ft. above the upstream toe, and open drainage holes 15 ft. deep were drilled below the gallery floor after the grout holes had been filled. The con-

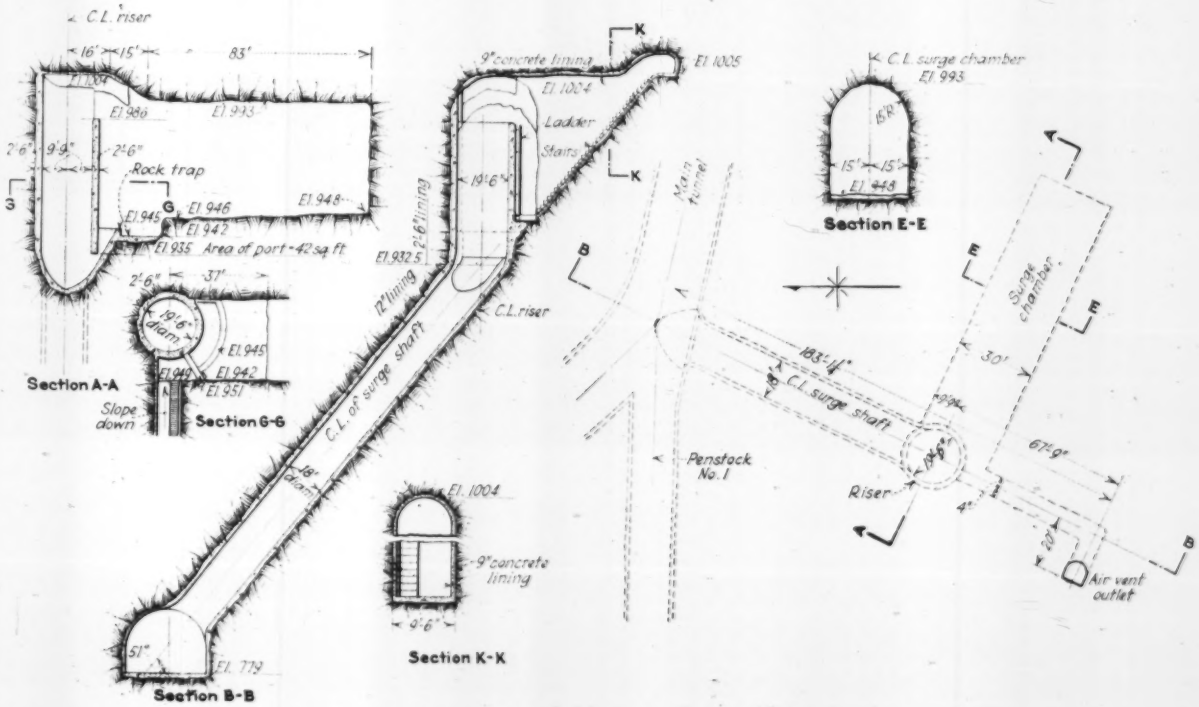


FIG. 8—DETAILS OF SURGE SHAFT AND CHAMBER

figuration of bucket deflectors and cushion pool dam was determined from experiments on a model built to scale of 1:100. The pool dam, deflection wall and intake structure require about 400,000 cu.yd. of concrete.

Intake Structure—The intake to the pressure tunnel is located adjacent to the right abutment of the arch and consists of three vertical 15x24-ft. gates, two sliding and one on rollers for opening and closing against a full head. To permit slow filling of the tunnel the roller gate is automatically limited to a 4-in. rise until the tunnel is filled. Three 23x62-ft. trash racks are made up in sections, with the frame so designed that racks and frames can be easily removed for inspection, painting and repairs. The racks and frames are of sufficient strength to withstand full hydrostatic pressure in order that an impervious curtain may be placed against their upstream face in the event that it is necessary to unwater the intake structure upstream from the gates. Racks and gates will be handled by a permanent stiff-leg derrick set above the intake.

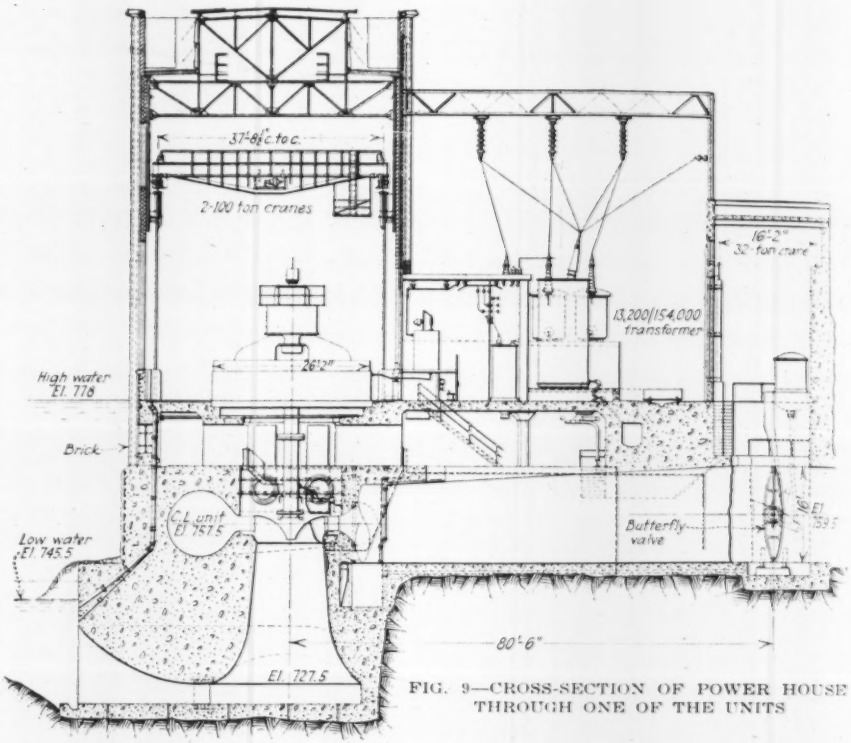


FIG. 9—CROSS-SECTION OF POWER HOUSE THROUGH ONE OF THE UNITS

Tunnel and Surge Shaft—Sections, plan and profile of the 2,400-ft. pressure tunnel are shown in Fig. 7. For the first 220 ft. the section is circular with a 13-ft. 3-in. radius. The remainder is a 26x24-ft. section with a circular crown. Both sections have a 12-in. minimum concrete lining. At the lower end the tunnel branches out into three penstocks, carrying steel pipes 16 ft. in diameter. Ellipsoidal gates hung from a monorail are provided in pockets at the head of each penstock, thus permitting unwatering any one without a prolonged shutdown of the entire plant.

A striking feature of the project is the differential surge chamber blasted out of solid rock, detailed in Fig. 8. The surge shaft, an 18-ft. circle within a 12-in. minimum concrete lining, takes off from the tunnel at the head of the penstocks (El. 779) and rises on a 51 deg. slope to El. 932.5. Here the shaft opens up into a differential surge chamber 124 ft. long, 30 ft. wide and varying in height from 42 to 55 ft. Immediately over the shaft at the end of the chamber is a vertical concrete internal riser 19½ ft. inside diameter and 51 ft. high, containing port openings totaling 42 sq.ft. in area at the bottom. The action of the water in surging will be to rise up through the shaft and riser, spilling over into the chamber, the small ports draining the chamber and serving to dampen the surge. As the chamber is unlined, a rock trap is provided to catch any rock scaling off the walls or floor. Access to the tank and chamber is from an air vent opening on the mountainside at El. 1005.

Power House—The power house, located on the bank of the stream, required 32,000 cu.yd. of excavation. The superstructure of structural steel and brick construction contains two 100-ton traveling cranes. Two complete 56,000-hp. units and all but the rotating parts of a similar third unit are being installed. Space adjacent to the back side of the plant is utilized for a transformer yard and switch house. Each of the three 16-ft. penstocks is controlled at the lower end by a hydraulically operated butterfly valve. A 32-ton traveling crane serves the three valves. A cross-section through one of the units is shown in Fig. 9.

To protect the power house from rocks rolling down the steep mountainside, a gravity section concrete wall, shown in Fig. 2, was built in the form of inverted V. A similar but smaller wall serves the same purpose in protecting the intake structure at the dam.

Personnel—The entire project is being built by the construction department of the Aluminum company under the direction of James W. Rickey, chief hydraulic engineer, and James P. Growdon, assistant chief. J. E. S. Thorpe is general superintendent in direct charge, assisted by B. S. Philbrick and Lex Phiffer. J. B. Hays is resident engineer, W. P. Bailey is office engineer and W. R. Johnson is concrete technician on the job. H. N. Hill is in charge of the arrangements for the arch deflection measurements. W. J. Mead, University of Wisconsin, is consulting geologist. Lars Jorgensen and F. W. Hanna are consulting engineers on the design of the arch dam.

Hungarian Government Rejects All Highway Bids

All bids for highway construction tendered to the Hungarian government in September have been rejected and new bids called for to cover construction of 1,200 km. of cement or bituminous roads. This action was taken because interest rates for the six-year period specified in the first proposals were too high. The revised terms call for a payment of one-third in cash, the balance in six annual installments.

Fig. 1—Successive Stages of Substructure Construction

Novel Sinking Equipment for Steel Cylinder Foundations

Threescore Cylinders Sunk in Deep Water by Riveting Sections on Top and Lowering With Gallows Frame—Piles Driven 50 Ft. Under Water—Seal Concrete Placed With 100-Ft. Tremie

SPECIAL equipment of interesting character was employed in sinking 56 cylinders 16 ft. in diameter and two cylinders 30 ft. in diameter for the piers of the two long highway bridges recently completed for the Florida State Highway Department over the two arms of St. Andrews Bay on the Gulf coast. The bridges, known as the East Bay bridge and the West Bay bridge, are respectively 4,000 ft. and 7,525 ft. long. Of the total length of the East Bay bridge, 1,240 ft. is hydraulic fill and 2,760 ft. is truss bridge on eleven piers in a maximum of 55 ft. of water; of the West Bay bridge 3,150 ft. is hydraulic fill and 4,410 ft. is truss bridge on nineteen piers in a maximum of 50 ft. of water. The fixed spans are steel trusses with concrete floors and have varying lengths from 160 to 225 ft.; the swing spans are respectively 200-ft. and 240-ft. steel truss spans with floor decks of treated timber. Except the swing spans, the decks of both bridges have 1½-in. asphalt surfaces.

Substructure Construction—All piers except the pivot piers for the swing spans consist of (*a*) below water, two 16-ft. concrete cylinders inside steel casings and supported by piles and (*b*) above water, two concrete shafts centered over the underwater cylinders, connected by a concrete web wall and having a cap over all. Across-bridge, the cylinders are 22 ft. apart on centers. The views of Fig. 1 indicate the character of the pier structure. The construction procedure and plant employed are illustrated by Figs. 2 to 4 and were as follows:

The cylinders were made of ½-in. plate reinforced with angles every 5 ft. and at connections. They were received on cars at Panama City in quarter-section rings, which were taken to the pier sites and assembled and riveted together on falsework (Fig. 2) in position for lowering. The bottom edge of the first section was reinforced with an extra plate and stiffening angles to act as a cutting edge. The falsework was built at each pier to accommodate two tubes and consisted of plumb and batter piles capped with 12x12-in. timbers and braced with 6x8-in. sash and 3x10-in. swaybraces.

The cylinders were lowered in sections, each hung on the falsework by suspender beams until the next section was ready, when the lowering operation was repeated. The cylinders were lowered by gallows frames (Fig. 2) with 12x12-in. x 50-ft. legs crossbraced with 6x10-in. timbers. At the top of each frame there were two 15-in. I-beams with two heavy U-bolts; from these hangers, or U-bolts, there were suspended two sets of steel blocks. This tackle was operated by two steel hand winches bolted to the legs of the frame. When the cylinder was lowered into position, the frame was picked up by a scow derrick and moved over to the adjoining cylinder or moved to another pier. The cylinders were then excavated inside with a 1½-yd. clamshell, and by a combination of excavation and jetting were lowered to the proper elevation.

Foundation piles 50 to 80 ft. long were then driven under water with an underwater steam hammer equipped with a sleeve extension to hold the butt of the piles. Where the driving was done under great depth of water, special cast-iron weights were attached near the tip of the pile to overcome buoyancy and were removed when the pile was set in the mud in position to drive.

The scow piledriver was equipped with 80-ft. leads for driving falsework piles, but when driving foundation piles the leads were used as a mast and an 80-ft. heavy trussed shear leg was swung out (Fig. 3), from which was suspended a set of 54-ft. swinging leads which contained inside the leads a steel sliding frame or spud with the steam hammer fixed at the lower end. These swinging leads were lowered by heavy steel blocks to any depth and 80-ft. foundation piles were driven with the hammer and butt of the piles 35 ft. under water.

A gravel cushion was then placed through the water in the cylinder and a concrete seal of sufficient depth to

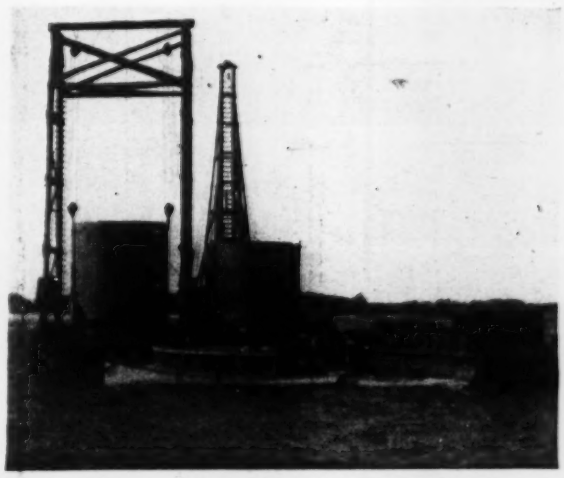


FIG. 2—GALLOWS FRAME LOWERING SECTION OF CYLINDER

resist flotation was deposited through the water with a 10-in. tremie 80 to 100 ft. long. After the seal concrete had set the cylinder was unwatered with pulsometer pumps and the foundation piles were cut off 5 ft. above the top of the seal. The remainder of the concreting was done in the dry by ordinary methods.

The concrete plant was mounted on a 20x90-ft. scow. The mixer was a 1-yd. steam-operated machine. Sand and gravel were unloaded from material scows by a derrick on the concrete scow. A wooden derrick mounted on the front of the scow raised and lowered the tremie. The plant had an 80-ft. wooden tower with sliding frame and receiving hopper and concrete was spouted to the tremie. The 80-ft. tower was unique in that it had no bracing in front and was open like a piledriver lead. The tremie consisted of a steel hopper in a steel frame, to which was attached 100 ft. of 10-in. wrought-iron pipe which could be uncoupled if shorter length was desired. The plant was equipped with electric lights furnished by steam turbine generators. In pouring the pivot pier seals an auxiliary ¾-yd. plant was set up on one of the derrick scows.

Superstructure—The steel truss spans were erected on falsework at Millville, near Panama City, and were picked up by two steel scows on which had been erected wooden bents of proper height to place the spans on the piers. The scows were equipped with valves and compartments to fill them with water if desired to lower the span and had gasoline-driven pumps to pump water out if necessary to raise the span. The scows were towed to the bridge site, a distance of about 4 miles.

Unusually good time was made in carrying out the construction. The contract called for completion in 450 days. About 60 days were used in erecting the equipment, and actual work started at West Bay on Nov. 7, 1927, when the driver scow started driving falsework piling, and work was completed on Feb. 7, 1929, a total of 457 days. All concrete was brought up out of water in one year from the time the first seal was poured. At East Bay the piledriver started driving falsework piling on Nov. 18, 1927, and all work was completed on Dec. 18, 1928, a total of 395 days.

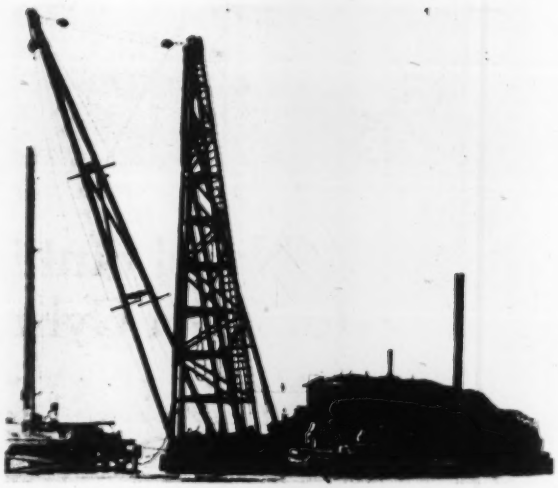


FIG. 3—SWINGING LEADS FOR UNDERWATER PILEDRIVING

Personnel—The contract was with the State Road Department of Florida, Fons Hathaway, chairman; J. L. Cresap, chief engineer; George L. Derrick, bridge engineer; R. L. Bannerman, division engineer; E. L. Hanes, project engineer, East Bay Bridge, and A. G. French, project engineer, West Bay Bridge. The construction was handled by the Northwest Florida Corporation, a subsidiary of Siems, Helmers & Schaffner, Inc., and Johnson, Drake & Piper, Inc., under the direction of N. F. Helmers, vice-president. The principal subcontractor was the Nashville Bridge Company.

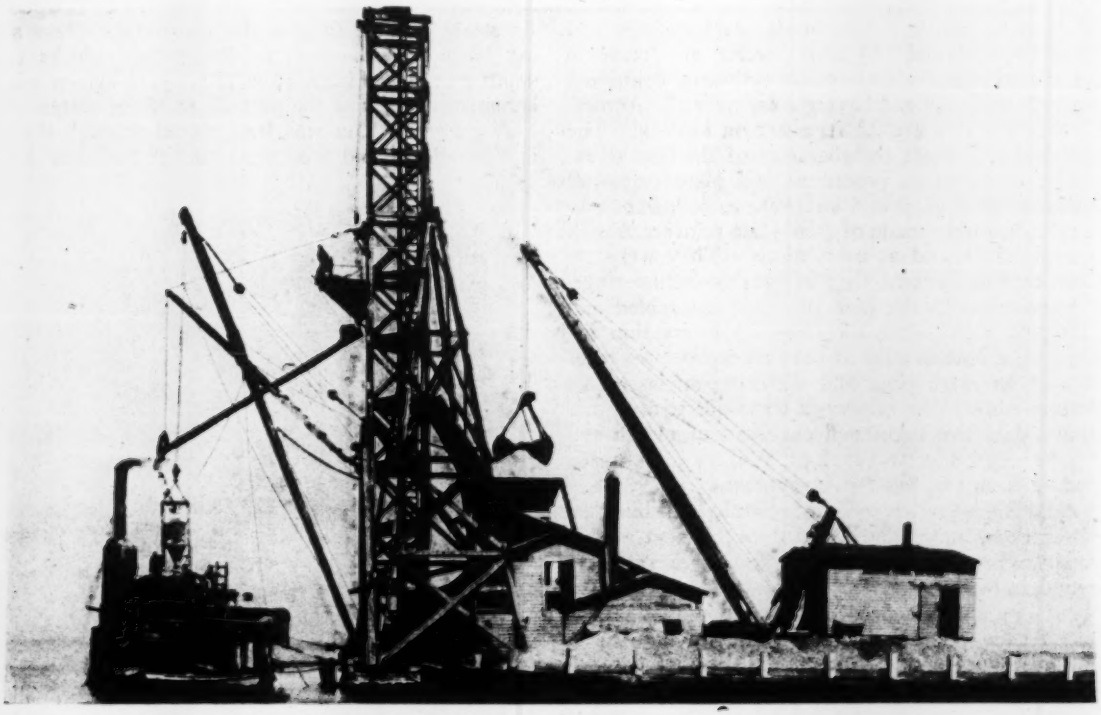


FIG. 4—FLOATING CONCRETING PLANT WITH 100-FT. TREMIE

New Knowledge of Roads

Highway Research Board Meeting Devoted Mainly to Outlining Questions Which Need to Be Studied—Maryland Reports Significant Change in Traffic Distribution During Past Decade—Balloon Tires Found to Prevent Corrugation of Gravel Roads—Culvert Strength Subjected to Mathematical Theory

OUTLINING future road research by analyzing the principal current problems and listing the questions which call for study formed the main occupation of the ninth annual meeting of the Highway Research Board, held at Washington Dec. 12 and 13. Actual reporting of new results had a minor place, but it brought out some important new knowledge. The attendance, in the neighborhood of 200, represented the usual degree of activity and interest; probably because of the nature of the program, however, there was little discussion of the papers and reports presented.

Reorganization of the board's committee work was decided on by the executive authorities, in order to bring about better co-ordination of related fields of study and more effective operating structure. The number of committees is to be reduced to six, each of broader scope than heretofore: administration and finance; highway transportation; design; materials and construction; maintenance; traffic and safety. In each field separate project committees are to be organized for work on specific problems, and the main committees will serve in advisory and correlating capacity. Prof. C. J. Tilden and H. K. Bishop were added to the executive committee, replacing E. W. James and Dean A. N. Johnson.

Research an Investment

There are too many roads today, said Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, in his opening address. The mileage must be reduced by turning back the land in many roads to useful purposes. Planning of highway systems is therefore an important matter for study. Other major questions arise from soil and subgrades, low-cost roads of adequate service character, efficient utilization of highway transport, effect of heavy vehicles, and finances.

Mr. MacDonald emphasized that research is an essential investment preliminary to road construction; unless part of the public funds for highways is regularly invested in research, these funds will not be utilized efficiently. However, research must be kept on a high plane; mere compilation is not research, but is at best only a preparation toward it. Further, aside from research of practical type, there is need of much work of purely scientific nature.

Further developing the theme of the objectives of road research, Roy W. Crum, director of the board, spoke of the large range of the unknowns. The financial phase includes benefit distribution, depreciation and operating costs, including time losses. Design is correlated with efficiency and safety. Soils, load distribution and maintenance methods are among the specific matters requiring active research. Of the larger divisions of the field, medium road types and earth roads are the most backward as to definite knowledge.

The latter subject was touched quite directly by Prof. D. P. Krynine, of Moscow, in an address on Russian soil investigations, as earth roads are almost the sole problem there and the prevailing traffic is horsedrawn. Since 1923 intensive study of soil physics has been carried on, in both field and laboratory. Moisture relations receive prime attention. The rolling of earth roads has had study; a large friction coefficient is essential to permit of effective compression. Clays are found to vary in water content with barometric pressure, indicating the effect of contained air, and it has been determined that all recent clays have this peculiarity; some older clays may also contain air. Permanently frozen soil layers affect road problems in Russia; they may be found at depths as great as 60 ft. to the top of the layer and 125 ft. to the bottom. Frost heaves of great size occur in places.

New Research Results

Some significant results were contained in the small number of research data reported. They include change in character of road traffic, dependence of washboarding of gravel roads on tire pressure and speed, and methods of analyzing culvert pipe strength.

Traffic Distribution Changed—Traffic survey figures in Maryland during 1917-20 and 1926-28, reported by Dean A. N. Johnson, of Maryland State College, reveal that a thoroughgoing change in monthly distribution has taken place within the five-year interval. The earlier

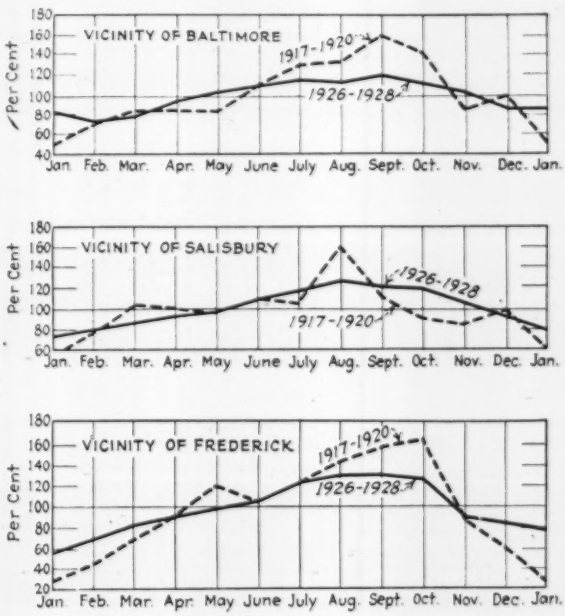


FIG. 1—CHANGE IN MONTHLY TRAFFIC DISTRIBUTION FROM 1917-20 TO 1926-28.

Mean line, marked "100 per cent," represents yearly average; irregular lines show monthly variation.

Baltimore, large commercial and industrial city; 1926-28 counts on nine radial roads, just outside city limits. 1917-20 counts on two roads.

Salisbury, village in truck-farm region of Eastern Shore peninsula; 1926 counts in five radial roads; 1917-20 counts on two roads.

Frederick, city in farm region in center of state; 1926-28 counts on seven radial roads, 1917-20 counts on two roads.

All counts were taken on one day per month, from 6 a.m. to 6 p.m.

period shows a high summer peak, while in the later period the traffic was distributed quite evenly over the warmer half of the year and dropped off less in winter. Apparently a condition of even spread of traffic over the entire year is being approached. The results are fully set forth in the three sets of curves in Fig. 1.

More restricted observations were made of the effect on stormy weather, taking one-hour traffic counts on seven pairs of comparable days during March and April, 1929. The ratio of rainy-weather to fair-weather traffic averaged 87 per cent (range, 67 per cent to 111 per cent).

Gravel Road Corrugation

Following earlier studies of the corrugation or washboarding of gravel roads carried out at Washington State College, Pullman, Wash., two sets of road tests were conducted there during 1928 and 1929, the former on a circular track of 175-ft. diameter and the latter on a 1.4-mile gravel road near Spokane. The results were reported by Homer J. Dana, assistant director of the engineering experiment station.

On the circular track a light car of short wheelbase was driven at 20-mile speed; it had either 3½-in. high-pressure or balloon tires, and in some runs was fitted with Houdaille hydraulic shock absorbers. With high-pressure tires washboards could be formed in 100 trips; when the shock absorbers were applied the corrugating action was much slower and it was not possible to make satisfactory washboards. When balloon tires were applied, no washboards were formed, even without shock absorbers.

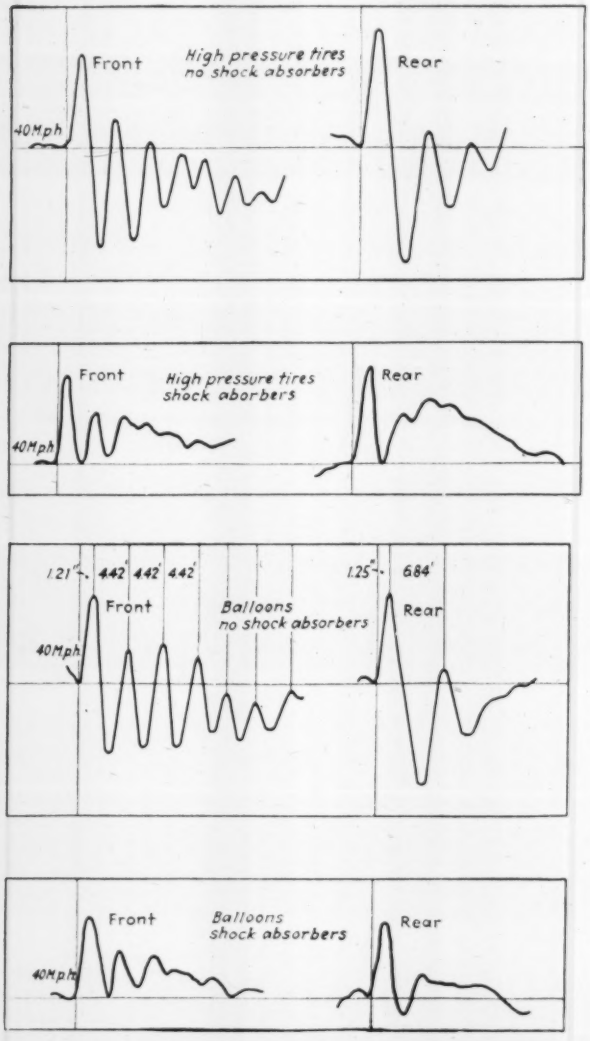


FIG. 2—CAR BODY VIBRATION FROM SINGLE BUMP 1½-in. bump 6 in. long. Records from separate pencils connected by wire to front and rear axles.

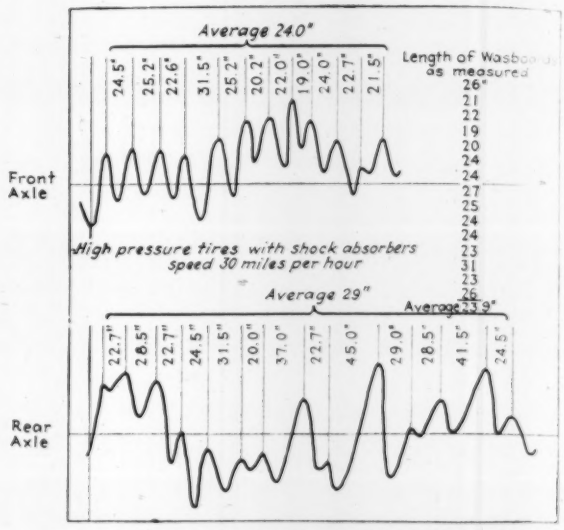

Average 24.0"
Length of Washboards as measured
24.5" 25.2" 22.6" 31.5" 25.2" 20.2" 22.0" 19.0" 24.0" 22.7" 21.5"
26" 21 22 19 20 24 24 27 25 24 24 23 31 23 26
Front Axle
High pressure tires with shock absorbers
speed 30 miles per hour
Average 29"
Average 23.9"
22.7" 26.5" 22.7" 24.5" 31.5" 20.0" 37.0" 22.7" 45.0" 29.0" 28.5" 41.5" 24.5"
Rear Axle

FIG. 3—VIBRATIONS ON WASHBOARDED ROAD

Records from same apparatus as Fig. 2, when driving at 30 miles per hour over a gravel road corrugated ½ in. deep and 23.9 in. length average. Successive washboards showed lengths as tabulated, but this particular group does not necessarily correspond to those of the vibration curves.

The straightaway tests of 1929 were intended to confirm and supplement the circular-track tests. The state highway department made available a stretch of road at Four Lakes, near Spokane, in the eastern part of the state, where during the very dry summers the clay binder of the gravel surface is weak. The 1.4-mile length had been bypassed by a new concrete road and therefore carried only light local traffic, ten to fifteen cars per day. Most of the length was level and straight. Before the test runs the road was planed so as to produce a loose cover 2 in. thick on a hard, smooth base. After each test run the road was again smoothed by scarifying and dragging, under such procedure as to avoid producing drag ripples.

For the tests a light car was provided with separate sets of wheels for hard tires (3½-in., 55-lb. pressure) and for balloon tires (4.40-in., 34-lb.) and with Two-Way shock absorbers. The car was driven at uniform speed of 25 miles per hour on one-fifth of the length, 35 miles on the next fifth, 40 miles on the next, 30 miles on the next, and 25 miles on the last. After reaching the end of the road it traveled back at the same speed for each section, and so on back and forth until washboards developed; the run was usually ended when they were still very slight, not more than ⅛ in. deep.

TRIPS REQUIRED TO FORM WASHBOARDS ON SPOKANE TEST ROAD

Run	Tires	Shock Abs.	Trips to Form Washboards at Following Speeds in Miles Per Hour			
			25	30	35	40
1	h.p.	No	100	91	36	50
3	h.p.	No	137	79	71	65
6	h.p.	No	146	76	60	50
5	h.p.	Yes	(290)	230	153	230
7	h.p.	Yes	180	188	105	92
9	h.p.	Yes	(350)	220	126	110
4	bal.	No			(360)	
8	bal.	Yes			(570)	

Note—(290) denotes that no washboards were formed by 290 trips. Shock absorbers were tested in only one adjustment, giving slight resistance to compression and considerable resistance to recoil.

Washboards appeared earliest on the highest-speed sections. Their length varied with the speed, being 21.14, 23.83, 26.47 and 29.32 in. respectively for the speeds of 25, 30, 35 and 40 miles per hour; at these speeds the lengths correspond to rates of vibration of 20.8 to 24.0 per second. No washboards were produced under balloon tires, even with runs extended to 360 and 570 trips, while under high-pressure tires they appeared at 36 trips to 230 trips. Shock absorbers retarded their formation. The full results are given in the accompanying table.

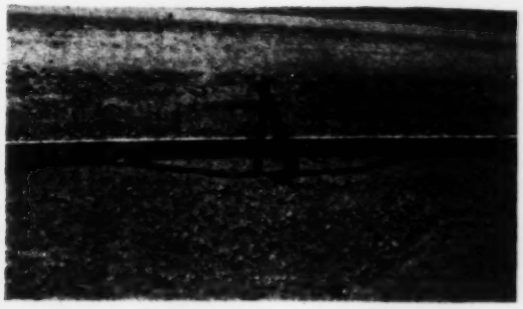


FIG. 4, AT LEFT—WASHBOARDS ON LOOSE GRAVEL ROAD. FIG. 5, ABOVE—WASHBOARD ON OIL-GRAVEL ROAD

The runs on the Spokane test road were stopped at an early stage of the washboarding and therefore the results are not readily shown in halftone view. They were of the same kind as the fully developed washboards in Fig. 4, showing a gravel road with much loose material on a hard base. The humps consist of fine and coarse material somewhat compacted but still loose enough to be moved easily. Fig. 5 represents washboards of another kind, formed in an oiled gravel road; little loose gravel is present, but here the humps are hard.

In a supplementary series of tests the vibrations of the car were recorded on a sheet of moving paper by pencils connected to the front and rear axles respectively. Some of these tests were made by running over a single bump 1½ in. high and 6 in. long, placed on a smooth gravel road. (Fig. 2 shows a typical record.) Others were made on a washboarded road (Fig. 3). They indicate that the two axles have different rates of vibration with respect to the car body, and that these rates differ from the washboard rate.

Climatological Factors—Prof. F. H. Eno, of Ohio State University, presented a large series of plottings of elements of climate in the form of iso-lines covering the entire area of the United States. They included temperature, rainfall, snow, sunshine days, fog, runoff and evaporation. It is expected that by aid of these plottings the results of road experience and methods of construction can be correlated with climate.

J. A. Sourwine, referring to the large magnitude of frost destruction of roads in some winters (as 1927-28, reported in *Engineering News-Record* of April, 26, 1928, p. 668), presented a method of studying frost attack by calculating degree-hour values of cold spells, the summation of the product of duration by degrees below a critical value, tentatively taken as 23 deg. F. With such a measure the frequency of destructive frost can be measured for different regions and correlated with frost-damage observations.

Value of Concrete Mixture Control—While not research results, some figures obtained from analysis of concrete road records in Iowa and reported by R. W. Crum, are of value as demonstrating the beneficial results of careful concrete control. A large number of separate road projects, each having many tests of specimen cylinders, beams and cores from the finished pavement, was brought together in comparative compilation for the years 1920-23 and 1928.

It was found that the concrete of the later period was not only much stronger but much more uniform. In the early years the mean variation of individual results from the project average was less than 10 per cent on only 36 per cent of the projects; in 1928 this fraction had increased to 68 per cent. Gravel and limestone gave almost identical results in the total average. Overrun of cement is much smaller in the later than in the earlier period. Cores from the road show satisfactory regularity, good gain of strength with age and close agreement with the average molded test cylinder.

Concrete Curing Methods—F. C. Lang and Fred Burggraf reported surveys of a large mileage of roads in a number of states in which the amount of scaling on concrete road surfaces was compared for roads that had been cured by dirt covering and by calcium chloride respectively. The results from the several states differed widely.

Subgrade Stability—A review of the correlation of soil study with practical subgrade study was presented by C. A. Hogentogler, of the U. S. Bureau of Public Roads. After outlining the wide differences between different soils in respect to (1) internal friction, (2) cohesion and (3) permeability, he indicated how combination of different soil constituents makes it possible to obtain the desired combination of these properties in subgrade material, dam cores and the like.

Culvert Strength—Final results of the long-continued studies of culvert strength at Iowa State College were presented by Dean Anson Marston in the form of a mathematical theory of earth loads on culverts. The full presentation is to be published shortly in a bulletin of the Engineering Experiment Station of Iowa State College.

Papers and Reports

Papers of general character included a descriptive discussion of aerial mapping by Prof. S. D. Sarason, of Syracuse University; a review of experience in water measuring at concrete mixers, by B. Myers and F. C. Lang, and an interesting address on road conditions in South America, by Pyke Johnson, this latter being delivered at the board's annual dinner.

More than half of the meeting was given over to reports of the standing committees (traffic, G. E. Hamlin; maintenance, B. C. Tiney; structural design, A. T. Goldbeck; materials, H. S. Mattimore; highway finance, H. J. Kirk; transportation, Prof. T. R. Agg; highway accidents, Dr. Knight Dunlap; mineral aggregates, W. J. Emmons). Dr. Dunlap, who has just organized his committee, reported the plan of work which it has set up. The other reports in the main presented classification and analysis of their subject, leading up to statements of present-day questions that require disposition by research, by formulation of policy or by empirical determination from experience.

Gas-Welding Shop Fabrication of a 300-Ton Mill Building

Equipment, Layout and Labor Problems Solved in Fitting a Structural Steel Fabricating Shop for Gas Welding

By H. M. Priest and H. H. Moss

Assistant Engineer, American Bridge Company, New York City, and Engineer, Linde Air Products Company, New York City

THE DESIGN and erection of the new Niagara Falls laboratory of Union Carbide & Carbon Research Laboratories, Inc., the first gas-welded steel building of major size, was described in *Engineering News-Record* last week. Being the first project in a comprehensive building program planned by the company, a large amount of development work was carried out. This article is devoted to a review of the facts determined from these studies and to a description of the shop fabricating procedure. —EDITOR.

IT WAS a requirement that fabricated steel for the new gas-welded research building of the Union Carbide & Carbon Research Laboratories, Inc., in Niagara Falls, N. Y., be delivered to the site within twelve weeks from the date of contract, or within two weeks of the delivery quoted for a riveted job. As the fabricator was not equipped to do gas welding, it was necessary to organize for all steps of welding and to recruit a crew of welders for a period of approximately six weeks. In order to demonstrate the practical value of modern gas welding, this crew was organized from "welders at large" who responded to advertisements placed in local newspapers.

In order to analyze the job from a welding standpoint for proper and systematic handling, the work was outlined as follows: (1) qualification of welders; (2) selection and inspection of materials; (3) design and layout of the welded joints; (4) preparation for welding; (5) organization and welding technique; (6) inspection and test.

Qualifying the Welders

The welders for the Niagara job were required to pass both tensile and bend tests before employment, shear tests not being demanded because the tensile strength was considered to provide an index to the shearing strength of the weld metal. Tests and preparations of coupons were made in accordance with standards and specifications of the American Welding Society and the American Society for Testing Materials. During the course of the job approximately 40 operators were considered whose experience ranged from welding of piping, tankage and aircraft to general job shop applications. Only a limited number had had experience with the high-strength welding rods specified for the Niagara job.

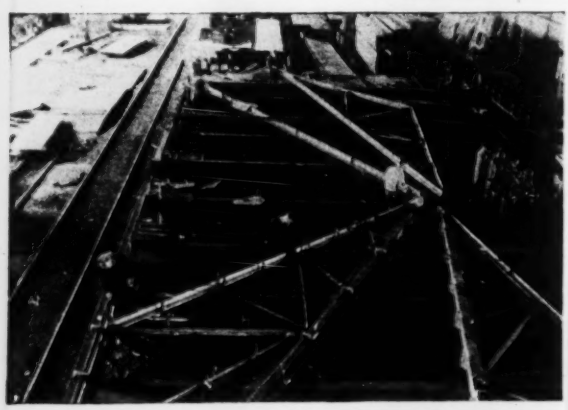


FIG. 1—TRUSS-WELDING STATION IN FABRICATING SHOP

A preliminary observation and a bend test were used to grade the applicants as they presented themselves for work, and while the results of these tests were fairly good, the general averages were below standard. It was, therefore, necessary to subject the men to a short training under proper instruction until their skill was developed to the required point.

Selection and Inspection of Materials

Structural steel conforming to American Society for Testing Materials Specification A-9-21 is good weldable base material and requires only standard mill inspection. High-quality welding rod was used, untested, because of knowledge of its quality. There is, however, a standard test for determining the suitability of welding rods and this should be employed where experience has not proved the suitability of a grade of rod.

Design and Layout of the Welded Joint

One of the principal factors in joint preparation is that of providing accessibility. In one case this may mean the preparation of the joint surfaces to be welded so that the welder can properly reach the bottom of the space which the weld is to occupy. In another case it may refer to assembling the joint so that a welder will have room to manipulate his tools properly and have an unobstructed view of his work. The position of the weld is also recognized as important and the best economy is obtained if the welds can be made in the flat position on planes lying between 0 and 45 deg. with the horizontal. Little difficulty is experienced in shop work in planning for all welding to be done in convenient positions.

Butt Welds—The joint preparation of material $\frac{3}{8}$ in. and over, to be butt-welded, is as shown in *A*, Fig. 2, if welded from one side only, and as in *B*, Fig. 2, if welded from both sides. For material $\frac{3}{8}$ in. and less in thickness, the type of joint shown in *C*, Fig. 2, can be used if welded as indicated by the dotted lines, or preferably as shown in *D*, Fig. 2. For material thicker than $\frac{1}{2}$ in. the double-vee preparation for butt welds makes for better welding economy. For joints similar to *E*, Fig. 2, it is good practice to bevel the edge of the inclined part so that good surface visibility is obtained.

Fillet Welds—With regard to the lap-type joints (Fig. 3), joined by fillet welds, no special preparation of the parts is necessary, other than cleaning. When beams of standard mill section are used, which have a

relatively thin flange edge, welds similar to Type *F*, Fig. 3, instead of the standard fillet, provide a greater throat strength and a shorter length of weld for a given stress. The reinforced fillet is restricted, however, to this type of detail.

Preparation for Welding

The shop schedule for routing the material to be welded over the welding skids provided what may be termed a truss station, a column station and a beam-and-miscellaneous station. Each station was provided with welding gases and apparatus at central points, overhead hand cranes and suitable clamps devised for the assembly of parts. The skids consisted of 24-in. I-beams laid on adjacent skids, turned over, and the welding completed. After the second week of truss welding, it was found expedient to assign certain operators to the jigged trusses and others to the trusses after removal from the jigs. By so doing, the conditions of welding for these operators remained constant, with a gradual improvement in rates of welding at each point. Fig. 1 is a general view of the truss station in the shop with all welding operations under way.

Column and Beam Fabrication—The main columns of the structure were assembled and welded in the sequence shown in Fig. 5. The unspliced and mezzanine columns were merely fitted with the details by the aid of clamps, and welded on either side in two set-ups. The simplest

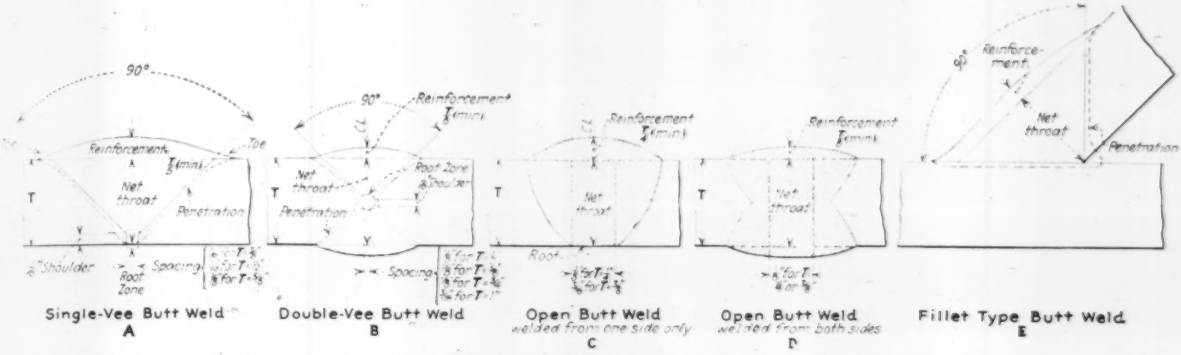


FIG. 2—BUTT WELDS SUITABLE FOR GAS WELDING STRUCTURAL STEEL

the floor of the shop in the form of a grillage, as shown in Fig. 1.

For this job, oxygen and acetylene were supplied in cylinders. Under sustained production, these gases probably would be furnished through pipe lines from a central distributing depot containing acetylene generators and manifolded oxygen cylinders. With such a central distribution point located on a railroad siding, gas cost as compared with that necessary on this job would be materially reduced.

Truss Fabrication—The trusses were assembled in a jig comprised of heavy structural angles secured to the welding skids. The jig accommodated a complete truss, wherein all accessible welding was done. As each half of a truss was completed in the jig, it was removed to work prevailed on the beams and girders which require assembly of web details only. These were fixed to the webs by special clamps, adjustable for varying depths of sections, and tack welding was thereby avoided.

The technique of welding was varied in order to determine the best methods. It was evident after several weeks' experience in shop fillet welding that the best economy was not being obtained through the employment of a common selection of a ⅜-in. standard fillets, except for special joints such as the crane column splices and crane beam brackets. The fillet welds shown in Fig. 3 were found to be the most favorable, taking into account the area heated by the welding flame for the different thicknesses of base metal. They also appeared to give the maximum rate and the minimum amount of

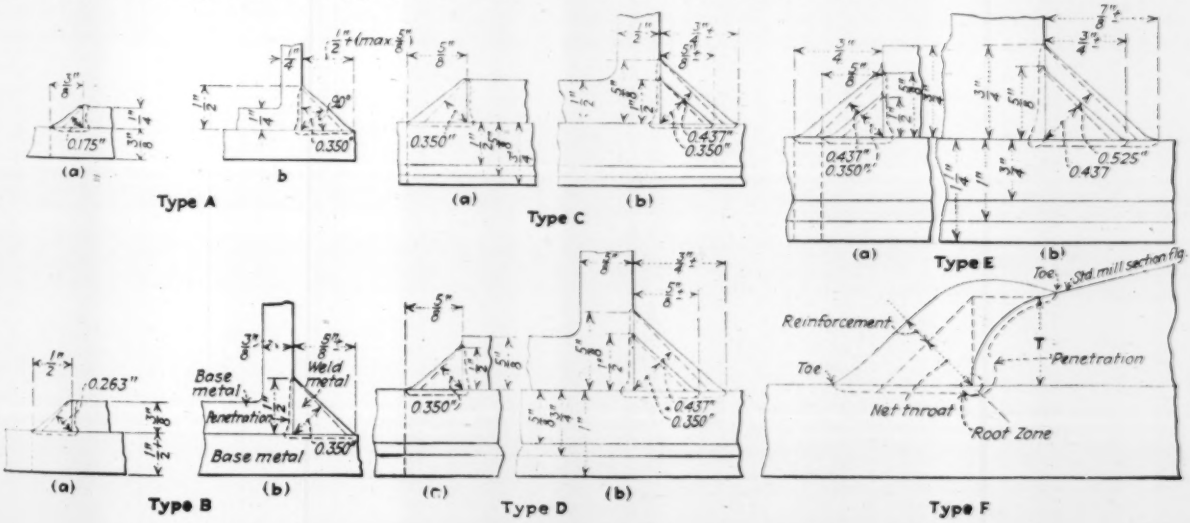


FIG. 3—LAP-JOINT FILLET WELDS DEVELOPED FOR GAS WELDING STRUCTURAL STEEL

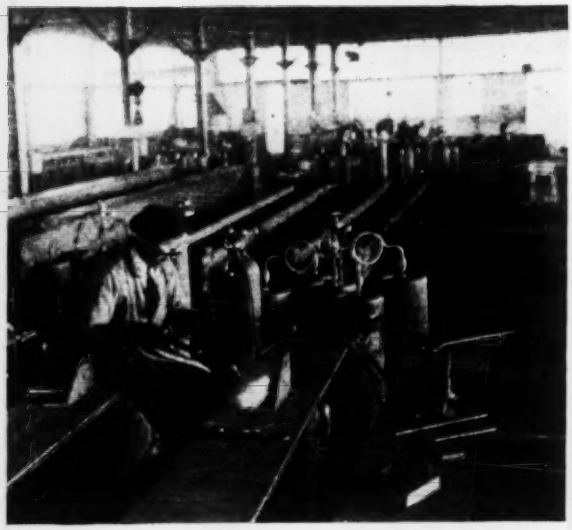


FIG. 4—COLUMN WELDING STATION IN FABRICATING SHOP
Note manifolded acetylene tanks and oxygen tanks to left of operator.

welding. Variations in these proportions are, of course, necessary depending upon the available length for a weld, the amount of stress to be transferred and code restrictions as to the minimum allowable length of welds.

During the early stages of the work special attention was given to each welder to see that he provided the proper amount of heat to the weld zone to cause the surfaces of the legs to melt simultaneously. Where the thickness of the base metal at a joint varies, the thinner material will heat up faster, unless the welding flame is concentrated more upon the heavier part. By radiation, the lighter material generally will absorb sufficient heat to require but momentary applications of the flame to cause uniform melting of the two surfaces.

With regard to the characteristics of the welding flame, the soft round inner cone of the flame is more desirable than the thin or pointed cone. The former spreads the heat and enables a larger area to be kept in the molten state. As the cross-section of the welds increased, larger welding tips and welding rods were used to increase the heat volume and the rate of deposition.

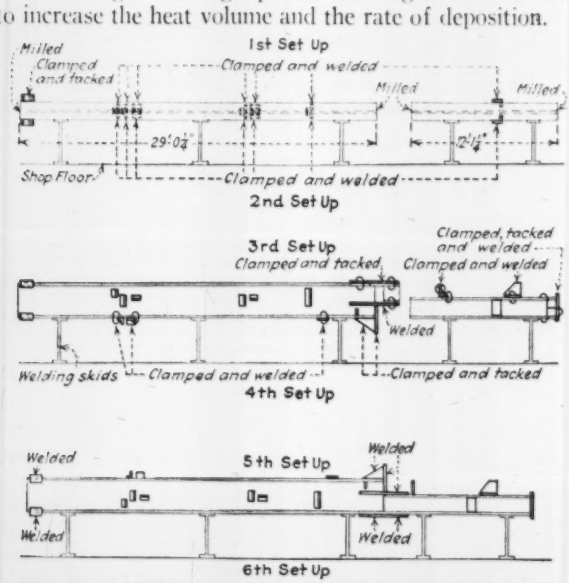


FIG. 5—ASSEMBLY AND WELDING PROCEDURE FOR MAIN COLUMNS

Warpage—Warpage generally has been considered inevitable in welding structural shapes. It is true that long slender sections will warp if the welding is unsymmetrical about the common axis. When it is required to weld such sections on one flange only, alignment can be maintained by several methods. Reverse bending of such sections similar to the manner in which welded pipe headers are constructed will generally prove satisfactory. Where the section cannot be handled in this manner, local reheating applied on the convex side at the point of maximum deflection will straighten the section. Welding applied at the ends of sections or for securing splice plates and beam clips seldom causes warpage. Welding on both sides of a detail simultaneously was found to reduce and in many cases to eliminate warpage. Members in an assembly such as a section of a truss, if

FIG. 6—GAS-WELDED COLUMNS IN FABRICATING SHOP SHIPPING YARD
Anchor bolt assembly consists of short length of pipe welded to the flanges of the column.

securely clamped or weld tacked, will lie sufficiently straight for all practical purposes. A great deal of warpage is avoided when the connections are designed to dispose the welds symmetrically about the common axis of the member.

The shop welding was started with two operators, the second week four were used, the third week six and thereafter an average of nine. All welding was completed by the end of the sixth week.

The duties of the welding inspector were as follows:

1. To determine that all welders had passed the required test before being placed on production work.
2. To inspect base metal and welding rods for conformity with the specifications.
3. To gage joint preparations and spacing of joint edges in butt-welding.
4. To check the characteristics of welding flames to see that the full rounded inner cone was maintained.
5. To observe the welding operations for proper fusion and weld soundness.
6. To gage finished welds for agreement with the specified dimensions.

Oversize and surface irregularities were characteristic of the average welds produced during the early stages of the work, but toward the end of the welding period

these were gradually being corrected, with resultant improvement in the rates of welding.

As regards the proving of strength of welded joints or assemblies, experience has demonstrated it to be unnecessary to test usual applications provided the welding has been done in accordance with recognized good practice and under proper inspection. On this job, destructive tests were made only on specimens resembling the anchorage detail at the base of the main and end columns (Fig. 6). The object of these tests was to determine the ultimate strength of the group of welds and the behavior of the joint under increasing loads beyond the designed strength, as well as the effect of the eccentrically applied load on the tubular parts. From these tests it was determined that the anchorage detail design for the job provided considerable excess strength over the amount actually necessary. The tests also showed that where the ratio of tube height to diameter is sufficient to keep the stresses at the outside terminals of the welds within the ultimate strength of weld metal at that point, shearing strength through the throats of the welds determines the ultimate strength of the detail provided the base metal has sufficient strength to sustain the load transmitted by the anchor bolt.

TABLE I—ACETYLENE AND OXYGEN CONSUMPTION

Tip Size, No.	Consumption, Cu.Ft. Per Hour Acetylene	Oxygen
8	22.4	23.5
10	29.2	30.6
12	42.8	45.0
15	56.4	59.2

The average rates of welding in inches per hour as developed during the latter period of shop fabrication are shown by the curves plotted in Fig. 8. The average acetylene and oxygen consumption in cubic feet per hour for different sizes of welding tips is given in Table I. The quantities are figured on an efficiency of 85 per cent—that is, the torch being in actual operation approximately 50 minutes out of each welding hour.

Conclusions

By co-operation of welder and fabricator in the solving of the development problem herein described, whereby the specialized experiences and facilities of both interests were brought into play, the work could be divided so as to give each one his logical part to handle. Thereby many of the problems in both design and construction were freed from cumbersome and at times impractical arrangements.

FIG. 7—FLAME CUTTING OVERLOOKED ERECTION BOLT HOLES AT FABRICATING PLANT

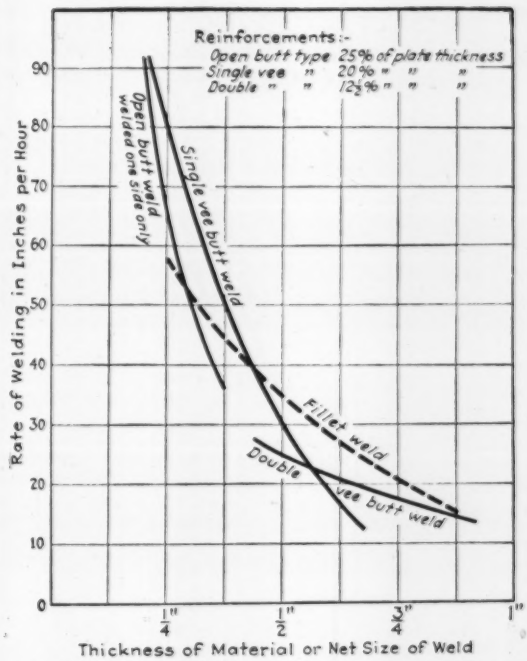


FIG. 8—AVERAGE RATE OF WELDING FOR FILLET AND BUTT WELDS

From the outset the job progressed at a good rate; it would have been completed in about the same time as a riveted job could have been completed except for the time spent in the establishment of the required production facilities, which is properly chargeable to development.

As the major objective in this work was to obtain application data under production conditions, it must remain for a future case to provide a clearer picture of costs for gas-welded construction of mill buildings. In this particular case the fabricating cost per ton of welded steel was above that of riveted construction.

With regard to fillet welding, the work demonstrated that economies can be gained through proper proportioning of the fillets with respect to the varying thicknesses of base metal encountered, as indicated in Fig. 3, *A* to *F* inclusive.

The conservation of heat by simultaneous welding about a joint or section makes for better economy in deposition. The use of constant-dimension shapes seems preferable. Simple but rugged jigs and clamps contribute appreciably toward the saving of time in assembly and eliminate much tack welding in the shop.

The experience on this job further brings out that the welder at large can be utilized if subjected to proper instruction and proof tests.

Harbor Works and Hydro-Electric Plant Planned for New Caledonia

Six German companies have been awarded contracts for the construction of new harbor works, warehouses, a hydro-electric plant and sewage works at Noumea, New Caledonia, a French colony near New Zealand. This work is to be finished within 40 months. The cost of 65 million marks is to be credited on the reparations account.

Eight Years of Litigation Over Seattle Bascule Bridges

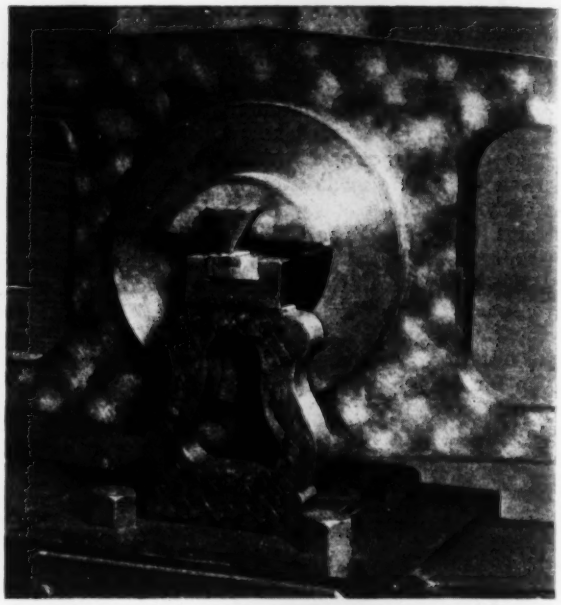
Harried by Patent Suits, City Develops Non-Infringing Design—Basic Patent Appears Invalid After All

SEATTLE has been the defendant for eight years in a series of lawsuits alleging bascule bridge patent infringement in two specific types of structures: (1) the trunnion bascule bridge of the transverse cross-girder type, such as was employed in the earlier bridges which Seattle built across Lake Washington Canal and (2) a trunnion bascule bridge with trunnion supports upon concrete brackets, a principle employed in the Montlake bridge. Early in 1925 a court decision expressed "grave doubt if there was any infringement" in the case of the latter type, but it was not until hearings in the appeal on this case that evidence was presented to show that application of the cross-girder principle has been used in precision scales for more than 50 years. News reports about the lawsuits were published in *Engineering News-Record*, Sept. 8, 1921, p. 421; May 31, 1923, p. 976; Feb. 5, 1925, p. 250; May 7, 1925, p. 782, and May 28, 1925, p. 910. The following is a brief résumé of the litigation. The patent in question expired June 11, 1928.

The first suit against the city of Seattle by the Strauss Bascule Bridge Company was filed in 1921 and claimed damages totaling $353,140 for alleged infringement by three Seattle bridges of patent 995,813, more particularly the claim therein referring to the use of a cross-girder in supporting a bascule bridge span. Subsequent to filing this suit the plaintiff secured an award of damages from Chicago as the result of similar action against that city in a case before the Circuit Court of Appeals for the Sixth Circuit (261 Fed., p. 358). Seattle's legal advisers then pointed out that defense of its case, regardless of whether it ended in victory or defeat, would cost $25,000 to $35,000 and that in view of the Chicago decision if a compromise settlement of the Seattle suit could be effected for not much more than defense costs, it would be good business policy to settle the matter out of court. City authorities were of the opinion that the claims of the patentee were invalid, but quite reluctantly it was conceded that as a matter of business it was wiser not to enter litigation and accordingly a compromise settlement for $45,000 was made.

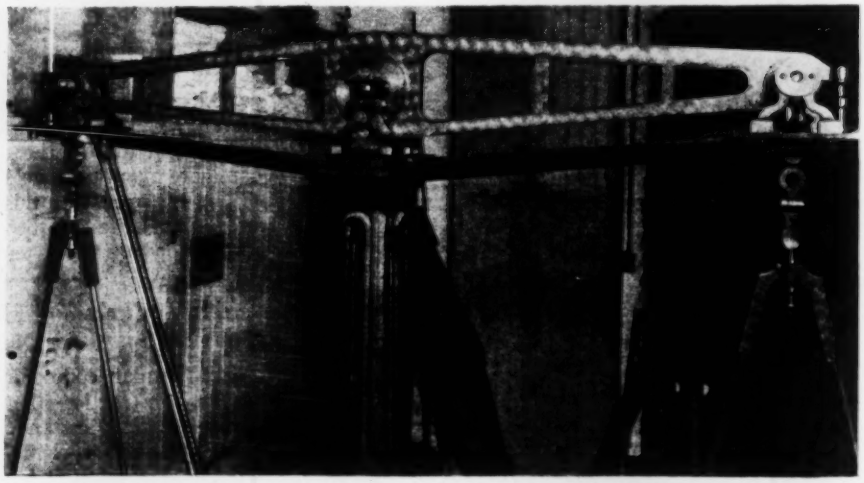
In 1923 suit was again brought against the city engineer and the city of Seattle by the Strauss company, this time for $119,000, principally for personal damages resulting from what plaintiff alleged were "libelous statements" in connection with designs for the West Spokane St. bridge. The city demurred to this complaint and the District Court sustained the demurrer. No appeal from this decision was ever filed.

Early in 1925, in connection with plans for a bridge on Montlake Ave., Seattle's bridge engineer developed a trunnion design for bascule bridges which it was believed would not infringe patent 995,813. The Montlake Ave. bridge was built according to this design and was put into service in June, 1925. (Description of this structure was published in *Engineering News-Record*, Nov. 19, 1925, p. 826.) Meantime, early in the construction period on this bridge, the Strauss company filed a suit alleging patent infringement and also asking for an injunction to stop construction (U. S. District Court, Western District of Washington, Cause 4,506).



TRANSVERSE SUPPORT OF THE PRECISION SCALE BEAM

The injunction was refused by the District Court, Jan. 14, 1925; appeal was taken and hearing had before the U. S. Circuit Court of Appeals at San Francisco. The latter court on April 20, 1925, sustained the opinion of the lower court in refusing the injunction, which sent the case back to the District Court for trial on its merits as a case of alleged infringement. Trial was set for July 1, 1925, but the case was never actually brought



GENERAL VIEW OF THE TROEMNER SCALE
Two scales of this type have been used in San Francisco for more than 50 years.

BASCULE BRIDGES DESIGNED AND BUILT BY THE CITY OF SEATTLE

Name of Bridge	Location	Year Built	Trunnion Span, Ft.	Type Trunnion Support
Fremont	Lake Wash. Ship Canal	1917	242	Transverse girder
Ballard	Lake Wash. Ship Canal	1917	218	Transverse girder
University	Lake Wash. Ship Canal	1919	218	Transverse girder
Montlake	Lake Wash. Ship Canal	1925	182	Concrete brackets
Spokane St. No. 1	Duwamish Waterway	1924	288	Longitudinal girder
Spokane St. No. 2	Duwamish Waterway	'29-'30	288	Transverse girder

to trial and finally it was dismissed on May 7, 1929. It was in denying this injunction that the District Court stated there was "grave doubt if there was any infringement."

The Circuit Court of Appeals, in the decision handed down at San Francisco, referred to "certain material evidence that was not before the court" which rendered the judgment against the city of Chicago in the suit brought by the Strauss company against that city. This new evidence related to two very large precision scales used in the U. S. Mint at San Francisco to weigh bullion. These scales were made by Henry Troemner, of Philadelphia, Pa., in 1871. Defendant alleged that they employ the identical principle covered by the Strauss patent, which claim, when established in court, would invalidate any patent on the same principle issued at a later date.

In the decision handed down in San Francisco the Circuit Court of Appeals indicated that the judgment of the court in the Chicago case might be set aside by reason of anticipation of the cross-girder principle in the precision scales.

The central support for the beam in these scales consists of a transverse support extending entirely through the plane of the main trussed beam and arranged to carry a transverse knife edge mounted within the truss beam. The knife edge is designed to rest throughout its length upon the transverse support. The scale truss beam has truss members entirely around the transverse support so that the beam may be pivotally mounted thereon. By the provision of ample clearance the beam is free to oscillate upon the transverse support without interference with the truss members of the beam. The larger of the two scales employing this principle has a capacity of about 5,000 oz. and uses a 5-ft. beam. The smaller scale has a 1,000-oz. capacity and a beam 42 in. long.

In reading claims 9 and 10 in patent 995,813, which cover the essential feature of the transverse girder, if the word "truss" is substituted for "bridge," the precision balance, it is pointed out, meets all the claims of the patent. The side supports of the scale correspond to the "two upright supports," the transverse support upon which the scale knife edge rests corresponds to the patented "cross-support" and the movable scale beam corresponds to the "movable section" of a bridge with truss members above and below the cross-support.

The accompanying table lists the six double-leaf trunnion type bascule bridges that have been designed in the office of the Seattle city engineer and built with contracts covering only construction and material. All have 40-ft. roadways designed for street cars, vehicles and pedestrian traffic.

Steel and Concrete Framing in Tall Chicago Building

A COMBINATION of reinforced concrete, structural steel and cast iron is employed in the framing of the 30-story Trustees System Building, now under construction at Lake and Wells Sts., Chicago, this combination being adopted for reasons of economy and convenience in the design. The building, 80x150 ft., rises 337½ ft. from sidewalk to top of 30th story, above which a pyramidal roof and smokestack inclosure extends 57½ ft. to top of masonry. A bank will occupy the first two stories, while the upper floors will be for offices. The foundations are concrete piers on hardpan 81½ ft. below street grade.

Column design includes structural steel with concrete fireproofing, ordinary reinforced-concrete and Emperger reinforced-concrete columns having cast-iron cores. In the lower stories the columns are from 36x36 in. to 32x32 in., reducing to 28x28 in. in the twentieth story, with smaller special sizes in the tower. Where cast-iron cores are used, their diameter ranges from 12¾ to 3½ in. for the lower and upper stories respectively.

Six of the columns under the tower are of structural steel to the 21st floor and two others to the tenth floor. Of these, two are wall columns and four are interior columns. The floor framing connected to these steel columns is also of structural steel. For the pyramidal roof and stack inclosure, the framing is of light structural steel, supporting cement tile slabs on the horizontal surfaces and brick on the vertical surfaces. Elsewhere the columns (30 in number) and floor framing are of reinforced concrete. All the basement columns have cast-iron cores, but in the upper stories the reinforcement varies according to conditions.

In general, the panels average 17 ft. 2 in. x 27 ft. 6 in., and no spans exceed this last figure. In the slab-and-joist floor system the slab is 2½ in. thick with joists 12x5½ in. spaced 35½ in. center to center. From the third to the twentieth floor the beams frame in the shorter direction and were made 14½ in. deep, thus providing a level ceiling for practically the entire floor. It was necessary to reverse the framing of the first and second floors in order to provide additional wind bracing east and west. Approximately 40 per cent of the east-and-west wind stress is taken by brackets on the structural steel framing, while 60 per cent is taken by deep concrete spandrel beams which are carried up from the lintels to the window sills.

The McLennan Construction Company has the general contract for this office building, the architects of which are Thielbar & Fugard, with James B. Black as structural engineer.

New York State Industries to Be Studied

Fact-finding investigations into economic and industrial conditions in New York State, particularly outside of New York City, will be conducted and studied by a committee of 25 representative business men and industrialists of the state, which will bring existing conditions to the attention of the people and suggest plans for improvement. The committee is the outgrowth of the New York Statewide Economic Congress held April 17, 1929, at which consideration was given to the decline in manufacturing industries in New York State and the effects of changing economic conditions on the welfare of the people. Subjects to be considered by the committee include: general tax revision, public expenditures, power, conservation, and utilization of the Barge Canal.

Motors and Control for Movable Bridges

Basic Factors to Be Considered in Selecting Electrical Equipment for Bascule, Swing and Vertical Lift Bridges

By H. W. Pittenger
General Engineer,
Westinghouse Electric & Manufacturing Company,
East Pittsburgh, Pa.

ALTHOUGH electric motive power has long been recognized as economical and reliable for operating movable bridge spans of the vertical lift, bascule or swing types, there are certain fundamental conditions and factors governing the selection and arrangement of the electrical equipment that deserve review from time to time as advancements in the art are made. Consequently, this article considers first some of the general factors surrounding electrically operated movable traffic bridges and then gives basic information on the selection and arrangement of such equipment as main motors, lock motors, brakes and control apparatus.

Each movable span, of course, presents its own individual problems. For instance, the amount and nature of the traffic over and under the span determines the degree of dependability of operation necessary and consequently the number of power sources required. The location of the bridge is largely responsible for the kind of power used. If a transmission line is depended upon, alternating current is usually available, but if the power must be generated, it is optional whether alternating or direct current is chosen. The amount of power required is difficult to determine, because of the many factors to be considered, such as the degree of counterbalancing, the weather, the condition of the bridge and the condition of the machinery. However, as is obvious, the power required decreases in direct ratio to the increase in the efficiency of the counterweighting; another important factor to remember is that the power consumption over a definite cycle, under similar operating conditions, will vary appreciably with the operator. Numerous tests have demonstrated this to be so.

Torque Considerations—For any size or type of bridge, the torque requirement is the initial point to consider. The next points in the order of their importance are: (1) the speed necessary to give the desired time of operation; and (2) the overload capacity likely to be required.

When alternating-current motors are applied, the speed remains essentially constant during the cycle of torques. On the other hand, when direct-current motors are applied, special attention is required to assure the proper opening time and to guard against excessive speed when the torque drops off as the span approaches the open position.

The torque required for a vertical lift counterbalanced span is essentially constant during the lift, with the exception of the short period when the span is accelerated. The fundamental force to be overcome is friction, but in some cases the unbalance due to wind, ice and snow presents conditions to be taken into consideration when determining the overload capacity of the motors.

For bascule spans (Fig. 1), the torque decreases as the span approaches the open position, and its value depends somewhat upon the cosine of the angle made by the span with the horizontal. The friction, depending upon the weight of the span, is essentially constant and is not affected by the angle. For swing spans, the torque

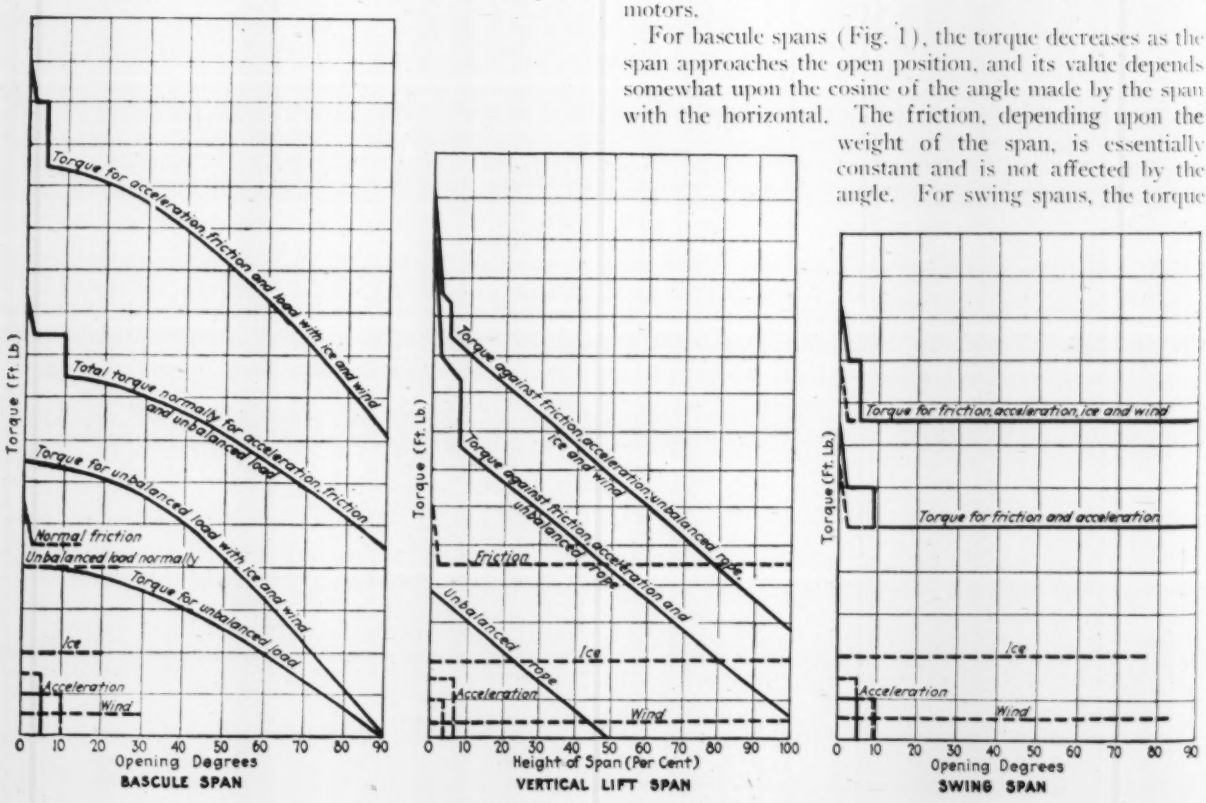

Torque (Ft. Lb)
Torque for acceleration, friction and load with ice and wind
Total torque normally for acceleration, friction and unbalanced load
Torque for unbalanced load with ice and wind
Normal friction
Unbalanced load normally
Torque for unbalanced load
Ice
Acceleration
Wind
0 10 20 30 40 50 60 70 80 90
Opening Degrees
BASCULE SPAN
Torque (Ft. Lb)
Torque against friction, acceleration, unbalanced rope, ice and wind
Torque against friction, acceleration and unbalanced rope
Friction
Unbalanced rope
Ice
Acceleration
Wind
0 10 20 30 40 50 60 70 80 90 100
Height of Span (Per Cent)
VERTICAL LIFT SPAN
Torque (Ft. Lb.)
Torque for friction, acceleration, ice and wind
Torque for friction and acceleration
Ice
Acceleration
Wind
0 10 20 30 40 50 60 70 80 90
Opening Degrees
SWING SPAN

FIG. 1—TORQUE CURVES FOR MOVABLE BRIDGES

requirement is as indicated in Fig. 1. Since the span is perfectly balanced, the only torque required is that for accelerating and overcoming static and kinetic friction. After the span has been accelerated, the torque remains essentially constant, the only deviation being caused by wind.

Choice of Main Motors—Generally, the power source available determines whether the motors are to be alternating or direct current, while the torque requirement determines the size and operating characteristics. If the power source is alternating current, a crane type, wound-rotor induction motor is almost universally used. If direct current is available, the mill type should be chosen. The series motor is not suitable, since it has a high light-load speed. Although it also has a high starting torque, this feature is not so important for main motors, since the starting torques are minimized by counterweighting. Emergency often requires one motor to perform the duty of two, a feature that cannot be overlooked when specifying a motor for bridge application. Then, also, there is always the possibility that the operator will partly lose control of the span, necessitating severe braking. At other times the span may strike the bridge seat with an impact that sets up severe stresses throughout the entire operating machinery. Such conditions, although not commonly experienced, nevertheless demand consideration.

The main operating motors need not be rated for longer than ½ hour. Because of the prevalent moisture conditions, they should be totally inclosed unless they are very well protected by other means. When the power requirement exceeds 25 hp., there should be two motors dividing the load equally, with provisions for cutting out one and throwing the entire load on the other in case of necessity. On very important bridges four motors are sometimes installed and are so arranged that any pair can be operated, with the other pair functioning as stand-bys. Normally, the speed of motors above 10 hp. should not exceed 750 revolutions per minute and that of motors less than 10 hp. should not exceed 1,200 revolutions per minute.

Motors for Locking Operations—Although the lock motors operate as frequently as do the main motors, the service is not so severe and they are not subject to such varying conditions. Lock motors are called upon to deliver a high torque, but only for a short period of time, so that they need not be rated longer than fifteen minutes. After the high torque is delivered at starting, the load falls to a negligible amount.

If the power source is alternating current, a high-torque, squirrel-cage elevator motor is generally applied, whereas if the source is direct current, a compound-wound motor will serve better. The compound-wound motor is nearly ideal for lock application, since it approaches the high starting torque of the series motor yet has sufficient shunt characteristics to keep down the light-load speed. The lock motor should be totally inclosed, since it is generally mounted in a position that subjects it to moisture.

Service and Emergency Brakes—The brakes on a movable span are important, for by their proper use the operator can maintain complete control of the span at all times. Each motor should be equipped with a solenoid-release spring-set brake with a torque rating not less than 75 per cent of the full-load torque rating of the motor. Usually a brake with an intermittent-rated shunt coil capable of exerting full-load motor torque is used, and the time rating of the coil should be equal to that of the motor to which it is applied.

On small spans, service brakes are sufficient, but on the larger spans, additional brakes are necessary for emergencies. The emergency brakes are identical with the service brakes in design, but the torque rating depends upon the point of application and the operating conditions likely to be encountered. It is not often that the emergency brakes can be applied to the motor shaft, therefore it is necessary to use a shaft of a greater torque rating because of the intervening gear reduction. The application of emergency brakes is more or less dependent upon personal opinion and experience. In some cases they are applied for holding duty only, with which arrangement all emergency brakes may be set at the same time. In other cases the emergency brakes are

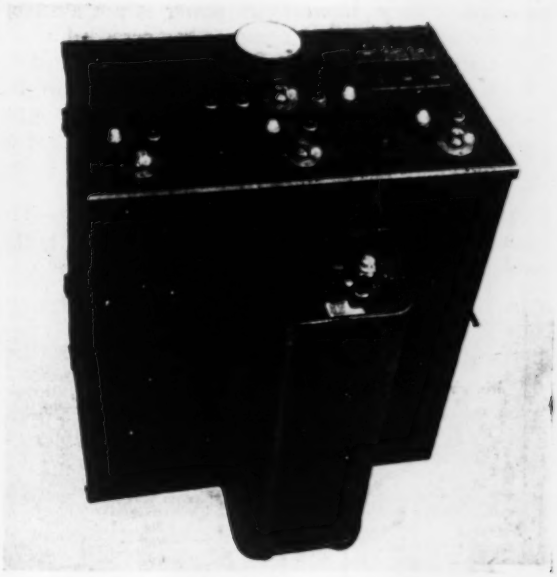


FIG. 2—A TYPICAL CONTROL BENCH FOR MOVABLE BRIDGES

used for retarding duty as well as for holding, in which event they must be arranged to be set one at a time so as not to produce too great a stress in the operating machinery.

The service brakes are connected to release when the motor is energized and to set in case of power failure or when the motor is disconnected from the line. However, provision is usually made in the control for one point to release the brake without energizing the motor. In this manner a "drift point" is provided to allow for coasting. When connected in this manner, the brakes are set automatically when the power fails or is disconnected from the motor.

The emergency brakes require their own individual control so that they may be used whenever needed, regardless of the position of the span. Their control is usually interlocked with the motor control so as to demand that they be released before the motors can be started. Since it is possible for the operator to leave the emergency brake energized after an operation, it is essential that the brake be provided with a continuous-rated coil. All brakes are provided with means for releasing them by hand.

Controlling Operation—There are certain features that must be incorporated in every control combination, such as overload and low-voltage protection and the inter-

locking features that go to provide safety and proper sequence of operation. The following is a typical sequence: (1) The first duty of the operator is to set the warning signals against traffic. (2) The next duty of the operator is to lower the gates against traffic. (3) After all gates are closed, power is automatically made available for releasing the locks. (4) The locks are released and the interlocking circuit is set up to give power for raising the span. (5) The operator allows the lift to continue until the limit switch opens the low-voltage circuit and stops the span in the "nearly open" position. An additional short lift can be obtained at reduced power by bypassing the limit switch, but there is seldom occasion for this additional lift. (6) After the traffic has passed under the span, the sequence is reversed. The limit switch brings the span to rest in the "nearly closed" position and must be bypassed to seat the span at reduced power. Here again power is not available for motion until the proper sequence has preceded it.

It is convenient to have indicating lights operated by the limit switches to furnish a visual indication of the position of the span, locks and gates. In addition to the lights, it is also customary to have a second means of indication such as a synchroscope position indicator located in the operator's room.

Fundamental Features of Control Equipment—The fundamental features commonly incorporated in a bridge control comprise the incoming line, apparatus for controlling the main motors, the locks, the gates and the brakes, as well as a signaling system.

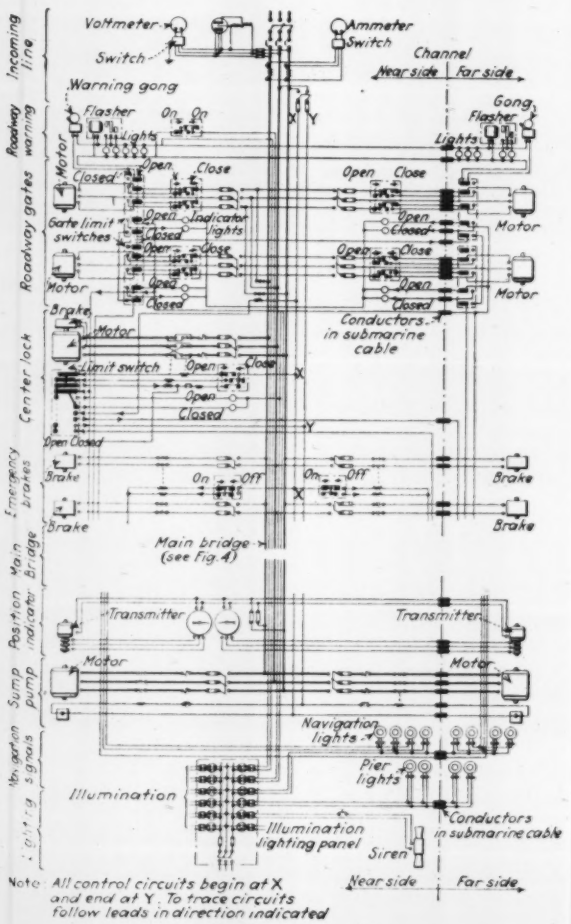


FIG. 3—WIRING DIAGRAM FOR LEAF OPERATION, DOUBLE-LEAF BASCULE
Note that this is part of Fig. 4.

Incoming Line—The incoming line requires little apparatus other than that necessary to provide the selection of power sources when more than one is available. If the source is alternating current, a circuit breaker with inverse time-limit attachment, phase-failure and a phase-reversal relay is used for protection in addition to the necessary switching equipment. If the source is direct current, the power is usually selected from one or two trolley circuits by means of remote-operated contactors, and here again a circuit breaker with inverse time-limit attachment is used for protection. (See Fig. 4.)

Main Motors—There may be one, two or four main motors grouped together with switching equipment to cut out any one or two and provide for operation by a manual or magnetic control. The equipment furnished to operate each individual motor is duplicated, the only variation being in the number to operate normally. For instance, if a group of four motors is installed with two operating normally and two for stand-by, control would be furnished by two motors, with provisions for switching either pair into service. A manual control may be used in cases where the motors are small and the currents are not too large to be handled by a reasonably sized drum controller, although some means should be incorporated to provide overload and low-voltage protection as well as limit switch protection. If the power is alternating current, these protective features can be obtained with a non-reversing line-starter, which includes a line contactor and overload relay, all inclosed compactly in a cabinet.

A magnetic control is necessary for the larger motors and is much more flexible, since it provides means for more interlocking and safety features. The current-carrying equipment is operated from a remote position with its operating switches grouped on a bench where it is readily accessible to the operator (See Fig. 2.) In either case limit switches should be provided to limit the span travel, to operate indicating and navigation lights and to stop the span in the nearly open, nearly closed, open and closed positions. To take the span past either the nearly open or nearly closed positions, it is necessary to bypass the limit switch and obtain three points of reduced power. This guarantees complete control of the span at a low speed.

The control bench provides mounting for the position indicator, indicator lights, meters, auxiliary control switches, bypass switches and master switches. A view of a control bench is shown in Fig. 2.

Locks—Center, rear and tail locks require identical control. The operating motors are usually small enough so that they may be handled either manually or magnetically with very little equipment. However, they should be protected the same as are the main motors, and require limit switches to insure proper sequence of operation by allowing power for span movement only after the locks are open. The control switches and indicating lights are located on the control bench. (See Fig. 2.)

Brakes—The service brakes must be controlled by separate contactors in order to obtain a drift point, a feature that is essential to the smooth operation of the span. Usually they are operated by contactors controlled by the master switch and arranged to release the brakes one at a time on successive points.

The emergency brakes are also operated by contactors, but by their own switch, and they are also arranged to be

released one at a time. Perfect control and smooth operation of the span depend upon the proper manipulation of the brakes. The individual control of the emergency brakes makes it possible to contend with variation in winds and other unexpected conditions that are not present during the normal operating cycle.

Signals—Signals, both automatic and manual, are important factors in the proper and safe operation of movable bridges. In cases where there are two or more persons involved in the operating routine, telephonic communication and buzzer systems are essential to keep each informed of the progress in the other's duties. Signals for traffic warnings consist of flashers for visible warning and sirens or bells for audible warning. The navigation lights show green or red when the span is respectively in the open or the closed position; the navigation lights and the indicator lights, installed on the operator's bench are operated by the limit switches.

The foregoing indicates the fundamental features that must be incorporated in the electrical equipment for all movable bridges. Regardless of the combination of these fundamental features that might be desired for any type of bridge, the only variation in the individual features is due to a difference in mounting of equipment or sequence of operation. Fig. 3 indicates a typical combination of features for a double-leaf bascule bridge with one operator and incorporates practically every standard motion for that type of bridge. The scheme could be changed considerably by arranging for two operators, by eliminating some one or two features, by changing the number of power sources or by altering interlocking details. Still, the individual features would remain fundamentally the same. On this basis, the electrical equipment can be greatly standardized.

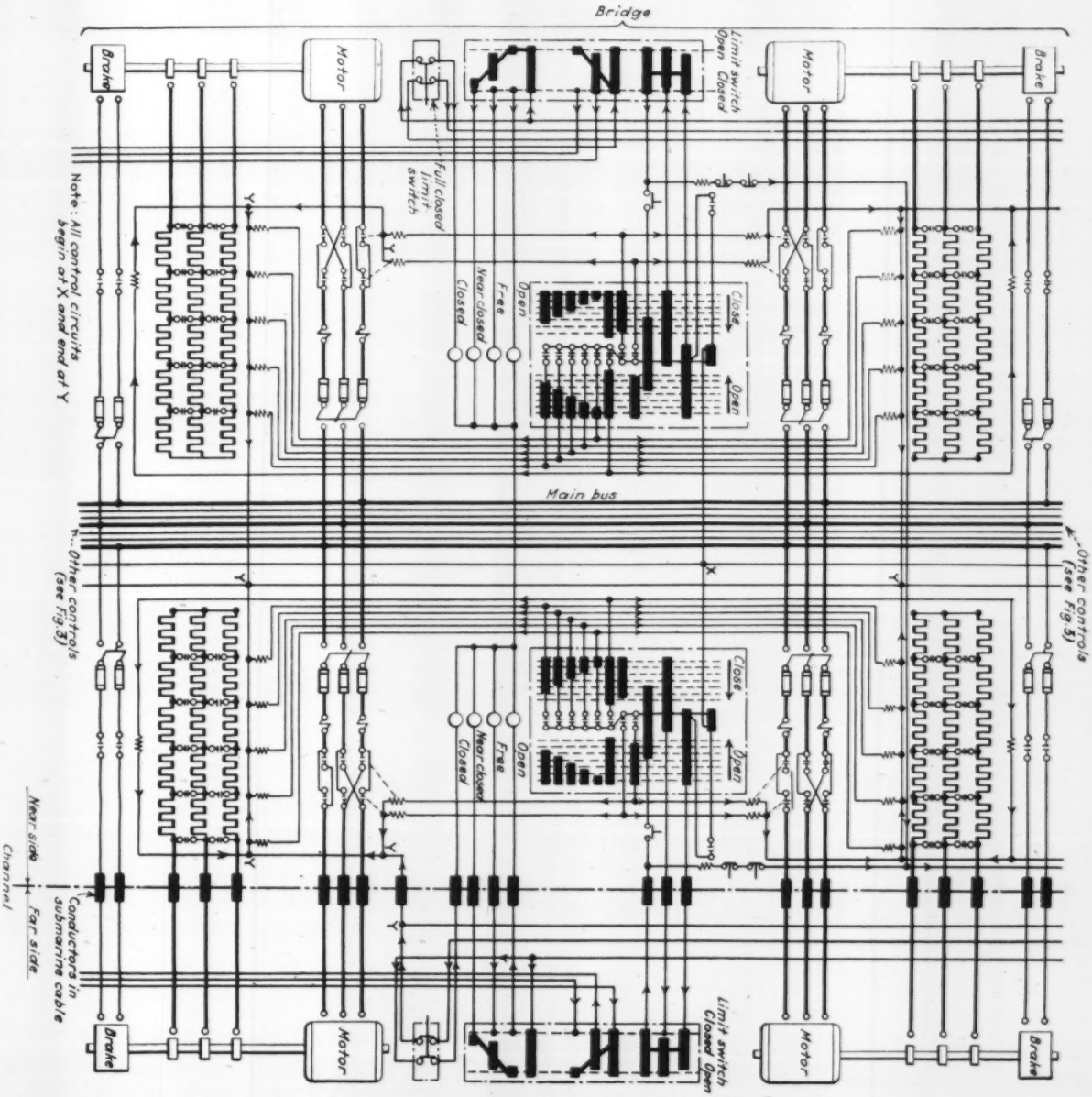


FIG. 4—COMPLETE WIRING DIAGRAM FOR DOUBLE-LEAF BASCULE BRIDGE

Note that the controls for each of the functions such as gates, brakes, main bridge, come from a main bus; each control is separate and standard. Note also that equipment is divided between the leaves, part being on one side and part on the other side of the channel.

Giant Incinerator Converts Paris Refuse Into Electric Power and Brick

Contractor Burns Garbage and Refuse in 1,100-Ton Plant Which Raises Steam and Produces Electricity for Works Purposes and for Sale—When Seasonally Necessary, Chimney Gases Reduce Moisture and Give Constant Steam Load

By Maurice Bricard

Directeur des Travaux de la Société Traitement Industriel des Résidus Urbains, Paris, France

Translated in abstract from *Le Génie Civil*, Aug. 10, 1929, by Russell L. Willard, Editor, Building Supplement, *Literary Digest*, New York City; onetime first assistant engineer to Mr. Bricard.

IN JULY, 1922, the city of Paris, France, began the execution of an extensive program of refuse-disposal plant construction and reconstruction, as described by me in *Engineering News-Record*, Nov. 22, 1923, p. 844. This program has been completed.

Four plants existed in 1922, all on the outskirts of Paris: one at St. Ouen, which carried the brunt of incineration in combination with the old plant at Issy, two more at Romainville, and another at Ivry. The last named contained an imposing installation of incinerators that had proved to be a failure, and at Romainville the furnaces were not very effective aid. The new program included a new plant at Issy described below, and extensive transformations at Romainville and Ivry, including the installation of new furnaces. A letter from M. Bricard, received by me Oct. 31, states that replacement of the St. Ouen plant by one larger than the new installation at Issy is now contemplated.

The accompanying table reproduced from my previous article summarizes approximately the additions to the incineration capacity.

GROSS INCINERATION CAPACITY IN METRIC TONS PER HOUR*

Plant	1922	1929
St Ouen	20	20
Issy	12	62
Romainville	14	20
Ivry		20
Total	46	122

*For the four plants the combined 1929 capacity per day of 24 hours is over 3,200 tons of 2,000 lb.; or allowing one-third idle for cleaning or repairs, more than 2,000 short tons.

Romainville and Ivry now work successfully, but this article is restricted to Issy. —Translator.

The new plant at Issy-les-Moulineaux, is among the most notable of the largest incinerators in Europe. The plant has worked perfectly since its completion nearly two years ago. With any four of its six furnaces in operation and two shut down for cleaning or repairs, the plant can easily handle 1,000 metric tons, or 1,100 short tons, of refuse per day of 24 hours. Heat from the burning refuse is used to generate electric current, the large excess of which over that needed for works purposes is sold to an electric light and power company, which in turn sells some of it to the city for pumping the municipal water supply. The mechanical equipment eliminates all hand manipulation.

The principal parts of the plant are as follows: a long pit for the reception of the refuse brought by covered automobile collection trucks; a mechanical system which gathers the refuse in the pit and permits its screening, drying and distribution to the furnaces; a battery of six furnaces; equipment for extinguishing and grinding; a brick plant for clinker utilization; an electric power station.

Reception of Refuse—Every morning between 8 and 10 o'clock the plant receives according to the season from 200 to 250 motor trucks each loaded with from 2,500 to 3,500 kg., or 5,500 to 7,700 lb., of refuse. Because of the system of collecting rapidly in a single turn of Paris, all these trucks arrive nearly simultaneously at the end of their route and it is necessary to be able to discharge them very rapidly to avoid congestion. Because of the layout and the rapid dumping mechanism with which the trucks are provided, only a few minutes elapse between the entrance and exit of a truck.

Manipulation of the Refuse—At all seasons the refuse can be burned in the furnaces without preliminary treatment. Nevertheless in winter it is profitable to extract the finer part, which is sold as fertilizer. In summer, when all the refuse is very wet, combustion is greatly facilitated by first drying it.

The refuse is taken up from the pit by means of 8-ton traveling cranes supplied with forked buckets of 4-cu.m., or 5.23-cu.yd., capacity. The load lifted is dropped into a distributor, which continuously feeds a system of belt conveyors. There are two of these belt conveyors, of 0.90-m. width (about 3 ft.) that work independently and symmetrically with respect to the center line of the plant, and these bring the refuse to the top of the building. A system of traps allows the refuse to be dumped directly into suspended buckets which feed the furnaces. These buckets, of 1,500-liter, or about 2-cu.yd., capacity, are connected with a cable which makes them revolve continuously on a monorail circuit at the slow speed of 0.3 m., or nearly 1 ft., a second. To fill them they are detached from the cable in such a manner as to stop them under the discharge trap of the belt conveyor. They are emptied from the bottom without being stopped in their passage above the charging orifices of the furnaces.

When the refuse needs to be ground or dried before being sent to the furnaces, it is not placed directly in the feed buckets, but goes first to auxiliary apparatus, divided into two complete systems that can work independently. Each consists of a distributor, a cylindrical screen and two driers. The screen and driers are each fed by a belt conveyor 80 cm., or about 32 in., wide. All the conveyors are mounted in parallel and one or more of them is fed by the distributor, which is mounted over them. Each distributor is a cylinder 1½ m., or 5 ft., in diameter and 8 m., or 26.3 ft., long, which revolves and is slightly inclined. The refuse enters at the higher end and as it

travels through the interior, a system of trap doors on the line of each transverse conveyor makes it possible to drop the refuse on any conveyor desired.

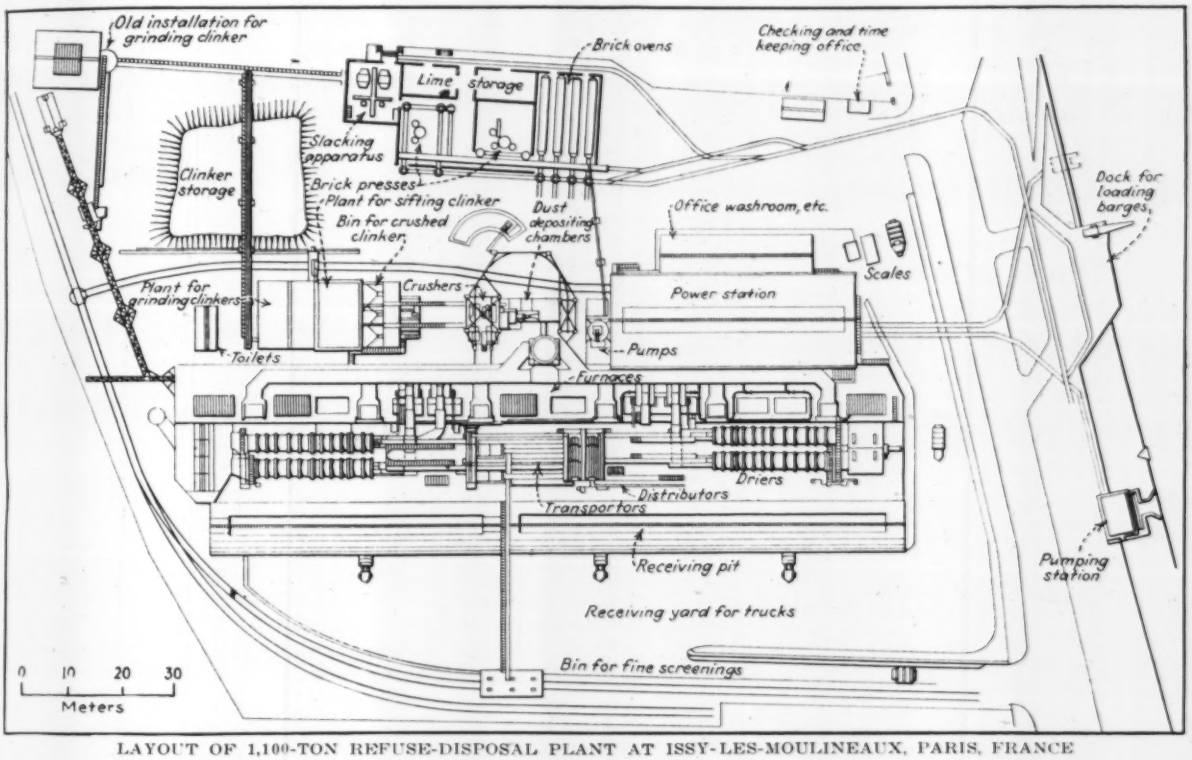
At the exit of the screens or the driers the matter drops by means of chutes into the traveling suspended buckets already mentioned. It is possible also to direct the residue from the screens to the conveyors which go to the driers. Thus the refuse may be screened or dried, or both.

The fine material extracted by the screens is taken by another belt conveyor to a storage tank of 400-ton capacity which is placed above the railroad siding in such a manner as to permit loading into railroad cars. Either half of the twin system may function independently at 60 or 70 metric tons capacity per hour, or 66 to 77 tons of 2,000 lb.

The driers at Issy consist of large rotating cylinders of sheet iron 3.5 m., or 11.5 ft., in diameter and 24 m., or about 79 ft., in length. Inclined blades following a helicoidal course keep the refuse progressing while the gases are passing through the driers.

The refuse remains in contact with the flue gases about 30 minutes. Yet the volume of the output of a single drier can attain 40 metric tons an hour, or 44 short tons. The gases enter at 220 deg. C. and leave at around 110 deg. The amount of water evaporated is about 7,000 kg., or 15,400 lb., an hour. At the exit of the driers the gases before escaping into the air pass through a depositing chamber, where they drop the largest part of their dust content; then they pass through a washing chamber, where the remainder of the dust is removed.

This drying installation was put into service in May,



LAYOUT OF 1,100-TON REFUSE-DISPOSAL PLANT AT ISSY-LES-MOULINEAUX, PARIS, FRANCE

The cylindrical screens are 2 m., or about 6.5 ft., in diameter inside and 4 m., or some 13 ft., in length. Their surfaces are of sheet iron perforated with holes of 25 mm., or about 1-in., diameter.

The percentage of screenings extracted depends on the season. In winter, when the refuse contains considerable cinders, the screenings extracted will reach 45 per cent. In summer this falls to 10 or 15 per cent, but the screening is not done except in cold weather. The rest of the time all of the refuse brought to the plant is burned in the furnaces.

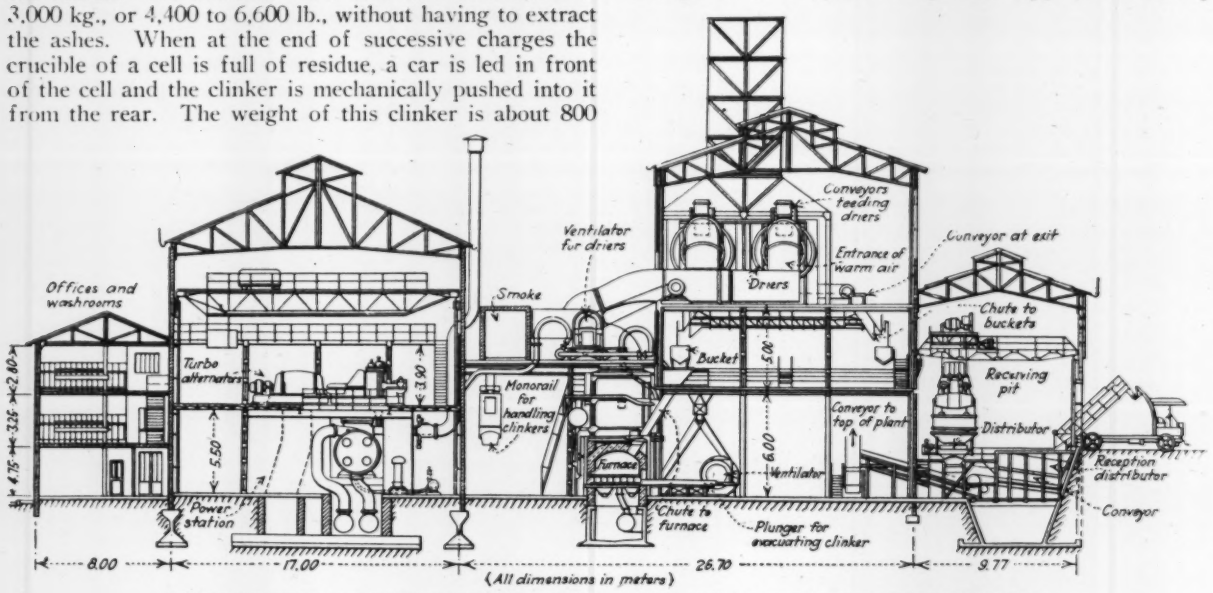
The Driers—While in winter the water content falls to less than 25 per cent, in summer it is around 50 per cent and sometimes attains 55 per cent. With so much moisture the combustion is difficult; the temperature of the gas of combustion, which is normally from 900 to 1,100 deg. C., decreases to 500 or 600 deg. But the temperature of the gas leaving the boilers varies only between 250 and 275 deg. C. It is clear what an advantage it is to use these gases ordinarily lost through the stack in making them pass into driers, where they come in contact with the wet refuse prior to incineration.

1928. As a result it was possible to get through the early part of summer, which is the period when the refuse is wettest, without any perceptible reduction in the production of steam from the battery of furnaces, and that in spite of the fact that the water content of the refuse was 55 per cent. So far as is known, these driers are the largest that have ever been constructed. The size of a great many of the parts did not allow their transport by railroad. They were made by the Ateliers de la Métallurgique Electrique at Ivry and were brought to Issy on a specially made truck which was permitted to cross Paris at night only. The weight of a drier during operation reaches 132 tons of 2,000 lb.

Furnaces—There are six Boussange furnaces, all alike, placed in a line in a building 140 m., or some 460 ft., in length. Each furnace comprises two groups of four cells placed on either side of a boiler. The cell of a Boussange furnace is a rectangular crucible of cast iron with double walls. The air that is forced under a pressure of about 30 cm., or 10.8 in., of water enters by the small end at the back and passes on either side through the space between the walls, passing next to the bottom and finally

penetrating through perforations in the bottom into the matter that is being burned. In its course the air cools the cast-iron walls while it is itself being warmed to about 120 deg. C. The small end at the back is crossed by a plunger that is mechanically controlled and which makes it possible to push the residue of combustion from the furnaces.

Each cell is fed by a chute into which the suspended buckets on the floor above are discharged. This chute opens in an orifice at the upper part of the vault of the furnace normally closed by a horizontal register. In opening the register the fireman lets fall a charge of from 200 to 500 kg., or 440 to 1,100 lb., weight according to the season. He can thus burn in a cell from 2,000 to 3,000 kg., or 4,400 to 6,600 lb., without having to extract the ashes. When at the end of successive charges the crucible of a cell is full of residue, a car is led in front of the cell and the clinker is mechanically pushed into it from the rear. The weight of this clinker is about 800 kg., or 1,760 lb. The entire residue almost always is ejected in a single cake.



CROSS-SECTION OF PARIS REFUSE INCINERATOR AND CLINKER-UTILIZATION PLANT

The hourly capacity of a cell is around 1,500 kg., or 3,300 lb. A furnace of eight cells burns 12 metric tons, or 13.2 short tons, of refuse per hour. This yield depends a great deal upon the activity with which the firemen stirs the refuse. Due to a system of bonuses allotted the personnel, the production has been held constant since the beginning of operation of the plant.

The heat produced in the cells is utilized in a Niclausse boiler, which carries a fan vaporizer of 360 sq.m., or 3,870 sq.ft., a superheater of 260 sq.m., or 2,796 sq.ft., and an economizer of 160 sq.m., or 1,700 sq.ft. As a result of putting the driers in service during the period of the dampest refuse, the production of steam has remained constant during the last twelve months at the rate of 12,000 to 13,000 kg., or 26,400 to 28,600 lb., of steam per furnace per hour at a pressure of 18 kg., or 40 lb., and a temperature of about 300 deg. C.

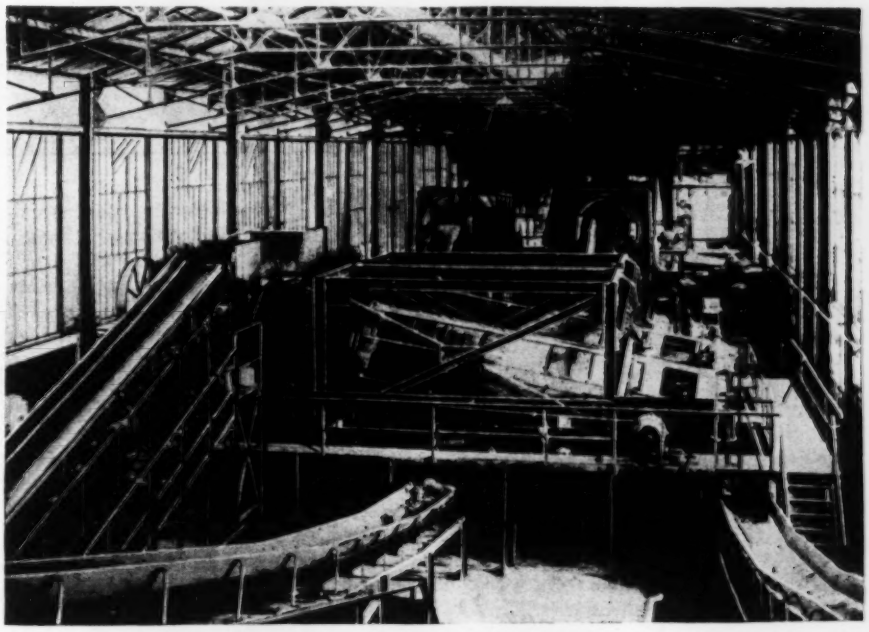
Air for forced draft is supplied through a pipe 80 cm., or 31.5 in., in diameter running the entire length of the battery of furnaces fed by a 150-hp. blower working at a pressure of 40 cm., or 15 in., of water.

Treatment of Clinkers—The treatment of clinkers, which amounts during the winter to 220 short tons daily, is a disagreeable operation. The clinkers are removed incandescent from the furnaces and must be extinguished, ground more or less finely according to their final use, and relieved of the tin cans and other pieces of metal which they contain in quantity.

The furnace cars loaded with ignited material are taken up by a monorail carrier with a capacity of 3,000 kg., or 6,600 lb., which drops them into a system of grinders. These grinders have two slowly rotating arms which carry large cams spaced sufficiently far apart to bite through the clinker, which weighs around 800 kg., or 1,700 lb. The clinker, broken in pieces of from 10- to 15-cm., or 4- to 6-in., size, falls in a trough about 26 ft. long, where it is carried along by a double chain with transverse bars and at the same time is plentifully sprinkled. This chain carries it, about three-quarters extinguished, to a cylindrical grinder supplied with strong teeth, which reduces the pieces to the size of the fist; from there a bucket elevator carries the ground clinker to a storage tower or bin of reinforced concrete, where it cools. From the storage bin the clinker falls into a crusher. A second elevator lifts the crushed cinders to a cylindrical screen, which classifies them in three groups: 0 to 15 mm., 15 to 40, and everything above 40 mm. in size (0 to 0.6, 0.6 to 1.6, and above 1.6 in.). It is among large sizes that the tin cans are found. The fine is ready for use in making brick. The medium is suitable for making concrete or may be further ground and added to the material for brick. The large material is suitable for use as fill. An installation of conveyors makes it possible to load these variously classified products on freight cars or send the fine part as well as the medium after regrinding to the brick plant.

A considerable part of the clinker is used to manufacture bricks by the silico-calcareous process. The brick plant is not new. It is operated in connection with the old incinerator. In this process the volume of the ground cinders is increased 7 per cent by the addition of lime and then compressed into bricks. These are hardened by treatment with steam, as a result of which the lime combines with the silica in the cinders. The plant has four presses which are able to produce 2,000 bricks per hour. The steam baking is done in four tubular ovens 15 m., or 50 ft. long, each with a holding capacity of fifteen platform trucks, each loaded with 800 bricks. The steam

is admitted at a pressure of 10 kg. per centimeter, or 142 lb. per square inch, and is maintained at this pressure for at least eight hours. The finely ground clinker contains a certain amount of quicklime, which tends to rupture the bricks when they are submitted to the action of the steam. Hence it is necessary to pass them before agglomeration into a special slaking apparatus. This consists of a slowly rotating cylinder of about 10-cu.m., or 13-cu.yd., capacity mounted on hollow axles through which steam is admitted. The plant is equipped with two machines of this type. The bricks obtained by this process are perfectly regular in form. Their resistance under compression is at least equal to that of the best bricks manufactured by the silico-calcareous process with sand. Their color, blue gray, is much brighter than brick manufactured from coal cinders.



INTERIOR OF PARIS REFUSE-DISPOSAL PLANT
Showing distributors, conveyors and screens

The whole plant at Issy was constructed with the bricks made on the site from the cinders resulting from the operation of the old Issy plant. These bricks have been satisfactorily used in walls and basements, in contact with the ground or in places especially damp. They can be objected to only for presenting efflorescent spots which appear after the construction of walls made with them. This efflorescence, formed by the sulphate of soda in the cinders, disappears eventually when rain has sufficiently washed the surface, but it temporarily disfigures the building. A special treatment recently perfected makes possible its elimination.

Power Station—The electrical station contains three groups of turbo-alternators of 6,000 kw., with three transformers of 7,500 kva. raising the voltage to 10,000. The electric current thus produced is sent to the lines of L'Union d'Electricité, a large light and power company. Two 1,000-kva. transformers furnish the electrical energy consumed under a voltage of 380 by the numerous motors installed in the plant. The power used by the plant is around 600 kw. As one turbo-alternator group of 6,000 kw. is generally maintained at full charge, the power furnished to the lines of L'Union d'Electricité is from 5,000 to 5,500 kw. The station also contains one turbo-alternator group of 750 kw., 38 volts, which can, when need arises, furnish the power necessary to run the plant.

The four turbines are provided with surface condensers with steam air ejectors. The circulating water is taken from the Seine to the pumping station through a 0.9-m., or 35.4-in., pipe. The pumping station has three vertical pumps run by 150-hp. motors. Each pump can operate at around 2,000 cu.m., or about 528,000 gal., per hour; any one is sufficient ordinarily for the needs of condensation.

Operating Methods and Results—During 1928 the plant had three furnaces constantly under fire which had been regulated for the production of 6,000 kw. In winter this production is constantly maintained from 5 a.m. until midnight and is discontinued during the five remaining hours of the twenty-four. In summer the insufficient tonnage of refuse does not permit the production of so much power for more than from ten to sixteen hours per day. During the coldest part of the winter, on the contrary, four furnaces may sometimes be put in action, which allows the attainment of 9,000 to 10,000 kw., even though a certain part of the refuse is at this time sent away and sold as fertilizer.

For the whole year, 173,000 metric tons, or 190,000 short tons, of refuse was burned. The gross production of electricity amounted to 28,500,000 kw.-hr., of which 25,200,000 was sold and 3,300,000 consumed by the plant. The best monthly average was observed in February, when 177 kw.-hr. was attained per metric ton of refuse burned (about 160 per short ton). The least satisfactory month was that of June, when this return decreased to 136 kw.-hr. per ton; this is the period of the year when the influx of vegetables results in very wet refuse. The average production for the year was 165 kw.-hr. per metric ton of refuse destroyed (150 per short ton). At no time during the year was coal added to the refuse incinerated.

These figures show how interesting the incineration of refuse may be from the point of view of production of electrical energy, which is necessary to the life of every great city. The difficulty presented by the disposal of an equal amount of power was recognized. Very happily an accord among the refuse-disposal plants of Paris, the Union d'Electricité and the water-supply service of the city was effected. The Union receives all the current which can be produced by the incineration plants; on the other hand, it furnishes to the pumping stations all the electricity which they need and which is comparable to that produced by the incineration plants. The incineration plants may thus be conducted to the best advantage without regard to the regulation of power according to the demands of a clientèle. The pumping stations are always assured of receiving the power that is necessary to their operation.

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

More Than a Good Textbook

Reviewed by JOHN H. GREGORY
Consulting Engineer,
Professor of Civil and Sanitary Engineering,
Johns Hopkins University, Baltimore, Md.

WATER SUPPLY ENGINEERING—By Harold E. Babbitt, M.S., Professor of Sanitary Engineering, and James J. Doland, B.S., C.E., Assistant Professor of Sanitary Engineering, University of Illinois. New York and London: McGraw-Hill Book Co., Inc.; Cloth; 6x9 in.; pp. 776; 333 halftones and line cuts. $6.

In the water-works field no textbook of equal importance to this has appeared in many years. As stated by the authors, the book is intended primarily as a textbook for use in civil engineering courses as presented in many engineering college curricula. It is not intended as a comprehensive treatise on water-works, nor as a handbook, but, as stated further on, would be useful to other than college students.

After a brief introduction and a short chapter on Finances, 33 pages are devoted to Hydraulics, 50 pages to Rainfall and Runoff and 19 to Consumption of Water. How far to present the subject of hydraulics may be a question, but the chapter could be materially improved, and could, to advantage, be expanded.

Groundwater, Location and Construction of Wells, Dams and Impounding Reservoirs, and Intakes and Aqueducts are treated in some 130 pages, of which 48 are given to dams and reservoirs. It would have been better to treat intakes and aqueducts separately and to expand each.

The next seven chapters, totaling 113 pages, deal with Steam Power, Steam Pumping Machinery, the Utilization of Electricity, Miscellaneous Engines and Pumps, Centrifugal Pumps, Well Pumps, and Pumping Stations and Equipment. The authors have done well to include a discussion of these subjects, notwithstanding that space permits only of a limited treatment.

Materials, Pipes and Fittings are treated in Chapter XVII (53 pages). Design of Distribution Systems, Distributing Reservoirs, and Construction and Maintenance of Distribution Systems fill 65 pages. The last chapter mentioned might well precede the chapter on Distributing Reservoirs.

In the chapter on Sanitation are presented the germ theory of disease, diseases borne by water, water-borne epidemics, typhoid fever as an index to sanitation, etc. There is a chapter on Quality of Water and one on Quality of Natural Water Supplies. The remaining topics are Purification, Sedimentation, Slow Sand Filters, Rapid Sand Filters, and Miscellaneous Methods of Water Purification.

There are three appendices: Outline of Report on Waterworks Design; Extracts from "Drinking Water Standards," adopted by the United States Treasury Department, June 6, 1925; Questions and Problems (129 problems). A 36-page index is included.

In the first edition of a book there are likely to be some errors; an odd one which has crept in is a column heading giving, for slow sand filters, the average amount of water filtered, in milligrams, and immediately adjacent, two column headings giving the rates of filtration in milligrams per acre daily. The first large rapid sand filter plant built in this country, at Little Falls, N. J., is recorded as at Little Falls, N. Y., and the second large plant built, at New Milford, N. J., is recorded as at New Milford, Ohio. In discussing the rate of filtration on slow sand filters the statement is made that the rate, where preliminary roughing filters are not used, is found to vary, in practice, between 2.5 and 7.5 m.g.d. per acre, as shown in one of the tables, and that the rate averages about 5 to 6 m.g.d. Average rates are, perhaps, about one-half of those stated, and in the case of the maximum rate cited, 7.5 m.g.d., evidently at Indianapolis, no statement is made that the filters run as modified slow sand filters, with a coagulant, for a portion of the time.

Unfortunately there are many references in which no dates are given, leaving the reader with no clue as to whether or not the material referred to is of recent origin. Again, the nomenclature used, in places, is not of the best. For example, in one place, in the formula for the discharge through an orifice, the symbol k is used for the coefficient of discharge, and in another place, c. Symbols with subscripts should, so far as possible, be avoided. But whatever symbols are used, especial care should be taken to have them accurately defined. In one place the reader is absolutely at sea as to the exact meaning of the symbols; the formula is quoted from another publication and the authors use different symbols than those in the original, which is unfortunate.

In general the line drawings are well executed, but in some of them the drafting and lettering is rather poor. They should have been redrawn so as to be more in keeping with the otherwise excellent appearance of the drawings.

Taking the book by and large, the authors have done a very creditable piece of work and have produced a book that is not only readable but in which the English is well expressed. They have shown a good grasp of the subject and evidently have carried on an extensive research into the literature of water-supply engineering. The writer is very glad to say that he has spent many enjoyable hours in carefully reading the book through from cover to cover. As a textbook, it is well put together to give a student a good idea of water-supply engineering. The water-works engineer and superintendent can well afford to add the book to his library, not for technical details but for general reading and explanation of many phases of the subject.

For Those Who Want to Get Ahead

ENGLISH AND SCIENCE—By Philip B. McDonald, Associate Professor of English, College of Engineering, New York University. New York: D. Van Nostrand Co., Inc. Cloth; 6x9 in.; pp. 192. $2.

There is increasing recognition of the fact that even though an engineer may be thoroughly conversant with his subject he will make little progress if he cannot impart his views lucidly to others, but if he is able to express his findings and plans in orderly and convincing language he soon forges ahead of those of his fellows who have not that facility. Professor McDonald's book is intended as a textbook for students in engineering

schools and lays down principles of correct writing to be absorbed and bad practices to be avoided. While the book contains little not to be found in other textbooks, it is written in entertaining style and has little of the pedantic manner common to most textbooks. Study of it under a competent instructor must be helpful to the conscientious student.

True to Title

Reviewed by HARRY E. SQUIRE
Assistant Harbor Engineer,
Board of State Harbor Commissioners,
San Francisco, Calif.

BASIC PRINCIPLES OF CONCRETE MAKING—By Franklin R. McMillan, Director of Research, Portland Cement Association. With an Introduction by F. E. Schmitt, Editor, *Engineering News-Record*. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 99; 32 line cuts and halftones. $2.

In preparing this work for practicing engineers the author has stripped the theory and practice of concrete making of much of the mummery in which it has been enveloped by modern laboratories and investigators. There is not a single formula or mathematical generalization in the book. Instead, the text is replete with graphs and tabulations summarizing a vast quantity of study and experimentation with directness and clarity.

The principle underlying the book is set forth in the first chapter somewhat as follows: Quality of concrete is determined by the properties of the cement and water paste binding the aggregate; properties of the paste are determined by two principal factors, the percentage of water in the plastic paste and the degree to which water is combined with cement in the set paste. This principle is not stated as an accepted premise for subsequent deductions but as a general theme to be developed in the subject matter following. The remainder of the book is an excellent example of inductive reasoning in which the generalizations are amplified, substantiated and applied.

The properties of the cement and water paste are taken up in Chap. II. The next chapter treats of the paste in its relation to compressive strength and presents in summarized form many data disseminated from the Research Laboratory of the Portland Cement Association. Chap. IV deals with the paste in its relation to equally important but less tangible properties, such as imperviousness and durability, and is valuable in that it makes available data which are not readily obtained by practicing engineers.

The next three chapters are devoted to the practical application of the principles in combining the paste with the aggregate—to making concrete. The inference is that the time-honored designation of concrete mixes as fixed ratios of cement and aggregate should be discarded in favor of fixed ratios of cement and water with variable additions of aggregate. The author has faith that economic pressure of cement cost on the one hand and labor cost on the other will limit quantities of aggregate to reasonable proportions. He does not seem to appreciate that fixed proportions are a logical consequence of construction through fixed-price competitive bidding and that the introduction of indefinite quantities may involve the unwary engineer in more awkward situations than those of controlling water at the mixer. The value of these chapters would be enhanced by differentiating between the procedure of designating concrete mixes previous to securing bids and that of attempting the same after the contracts are let.

The methods advocated are simple and logical and consist of selecting the proper cement and water paste for the desired strength, durability and conditions of curing; then, in proportioning the aggregate for maximum workability and minimum cost. The author discards sieve analysis in favor of trial mixes and in doing so shows an insight into the actualities of concrete manipulation. This is substantially the final resort of many experienced technologists, who use their pots, sieves and kettles to frame the backbone of the mix and then adjust it for workability by inspection in the field.

The two chapters on aggregate selection and construction methods are somewhat of an anticlimax. The commonplace nature of making concrete in the field has too frequently resulted in neglect by the engineer and the author again indicates a broad insight into actualities in stressing the importance of proper construction methods.

There are few engineers who cannot find interest, enjoyment and profit in this book. The young graduate will be aided in acquiring a commonsense viewpoint to supplement his knowledge of fineness moduli, slump tests and other recent refinements; and the senior of 30 years' experience not only a new insight through the wealth of tabulated data but also much of interest in interpreting past experience through the medium of the basic principles presented.

A Primer on the Building Field

BUILDING CONSTRUCTION: Types of Construction, Materials and Cost Estimating—By Whitney Clark Huntington, C.E., M.A.S.C.E., Professor of Civil Engineering, University of Illinois. New York: John Wiley & Sons. London: Chapman & Hall. Flexible; 6x9 in.; pp. 596; line cuts and halftones. $6 net.

This is in large measure a book of definitions pertaining to the modern field of building construction. Planned as a text to familiarize technical students with the terms employed, with the organization necessary and with the materials and their various fields of usage, the book should fulfill its author's intentions well. Older engineers, too, will benefit from the review it presents of a division of the profession that is developing at an unprecedented rate. The chapter on the chemistry of structural materials is well worth reading. The elementary discussion of foundations, walls, framing and types of stresses should prove useful. A good chapter on wood framing is included. The chapter on modern rolled steel sections should be helpful to those who are not yet familiar with the advances that have been made in this field. The various types of reinforced-concrete construction are described. Fully a third of the book is devoted to such important subjects as floors and floor surfaces, roofs and roofing materials, doors, windows, plaster and stucco, and paints. A special feature of the book is the use of examples and illustrations depicting the latest modern trends.

Airports and Their Operation

INTERNATIONAL AIRPORTS—By Stedman S. Hanks, Lt.-Col. Air Corps Reserve. New York: Ronald Press Co. Cloth; 6x9 in.; pp. 195; 46 line cuts and halftones. $6.

This book should be of interest, and perhaps of some practical use, to airport engineers and city planners. The title is somewhat peculiar. Apparently it is derived from the fact that both European and American airports are considered. Relatively few airports are described, but Tempelhof, Le Bourget, Croydon, Amsterdam, Rotterdam, Copenhagen and Rome are well outlined, as are

the American fields at Buffalo, Oakland and Chicago. There are chapters on the directing personnel of airport operating companies and air transport lines. Chapters are given on passenger and freight handling in Europe, airport building, communication, insurance, lighting, etc., all from the European angle. The author points out Italy's fine development of seaplane bases, England's two-way radio, Germany's air-rail tie-up for packages and freight and our own night-flying pre-eminence.

Centralized Public Purchasing

GOVERNMENT PURCHASING—Russell Forbes, Secretary, National Municipal League; Secretary, Governmental Research Association; Director, Municipal Administration Service; and Lecturer on Municipal Government, New York University. New York and London: Harper & Bros. Cloth; 6x9 in.; pp. 370; 80 line cuts. $5.

The present extent of centralized governmental purchasing in the United States and Canada, the underlying theory of such purchasing and details of practice, with their shortcomings, are well covered in this handsomely made volume. Our own federal government, in the author's opinion, leads in the practice of central purchasing. Of our states, three-fourths have adopted the principle to some extent, with varying degrees of excellence in practice. Among our 3,000 counties, only 100 have taken up central purchasing. Proportionately, our cities have done better than our counties, for in 1926, according to a survey by the author, 210 cities, counting only those with populations of more than 10,000, had adopted the principle. Below 10,000 the survey showed 19 cities, with no pretention of completeness. The survey showed 22 Canadian cities also. Practically all this, at least in the United States, has come about since 1900, only two instances prior to that year being on record. As testimony to the manager plan of government, Mr. Forbes states that of 109 cities with more than 10,000 population which had city managers in 1926 all but sixteen had centralized purchasing.

Unique in Authorship and Scope

PUBLIC CLEANSING: Collection, Treatment and Utilization of Town Refuse—By The "Jas. Jackson" Study Circle of the Birmingham Corporation Salvage Department. London: Ernest Benn. Cloth; 8x10 in.; pp. 251 + advertisements; halftones and line drawings. 18s.

In authorship, scope and method of treatment this book is unique. It is the outgrowth of a "class" formed by the general manager of the salvage department of the city of Birmingham "for the education of the members of" his staff. As the fame of the "class" spread men from other cities were attracted and became members. One object of the "study circle" is preparation for the examinations of the Institute of Public Cleansing. Sixteen lecturers, each experienced in some branch of garbage and refuse collection and disposal and street cleaning, have collaborated in the production of the broadest and most intimate treatment of the subject yet published.

Although every author is or has been on the Birmingham salvage department staff, what they write is not confined to Birmingham practice. There are a few tables, from Ministry of Health returns on the refuse and street-cleaning service in a considerable number of cities. Little attention is paid to practice outside of Great Britain, but most of the contents of the book would be either directly useful or helpfully suggestive to engineers and officials having to do with refuse collection and disposal and street cleaning anywhere in the world. Hering and Greeley's "Refuse Collection and Disposal" is in several ways more comprehensive than the new British book, which, for instance, has only a few lines on garbage reduction or on disposal by feeding to hogs, the latter confined almost wholly to humorous remarks on hogs in the streets of New York, from Dickens' "American Notes," of almost a century ago.

In manufacture the book has one great fault: The type page is 6 in. wide. This combined with a smallish type makes reading the volume a severe strain on both eyes and patience. Nearly all the cuts and most of the tables in the text are 5 in. or less in width and most of those that are not could have been made so without sacrifice; so it would have been quite possible to have used a 5-in. type measure, or even 4½ in., which is about the readable limit for books as closely printed as is this one.

Wide reading of the book this side the Atlantic, with close study of some of the parts, would add greatly to the economy and efficiency of our street-cleaning and garbage-refuse-disposal services.

Location and Construction

HIGHWAY LOCATION AND SURVEYING—By W. W. Crosby, M.Am.Soc.C.E., and George E. Goodwin, M.Am.Soc.C.E., Formerly Chief Civil Engineer National Park Service, U. S. Dept. of the Interior. Chicago: Gillette Publishing Co. London: E. & F. N. Spon, Ltd. 57 Haymarket. Cloth; 5½x8 in.; pp. 398; illustrated. $5.

THE CONSTRUCTION OF ROADS AND PAVEMENTS—By Thomas Radford Agg, C.E., Professor of Highway Engineering, Iowa State College, M.A.S.C.E., A.S.T.M., Soc. for Prom. of Eng. Educ. Fourth Edition. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 511; illustrated. $4.

In a volume of three parts, each quite different from the others, the two authors of Highway Location and Surveying have produced a most interesting text on the philosophy, principles and practices of highway location. The book only in slight measure conforms to the requirements of a working manual for the field party. It is rather a text for the chief engineer who considers highway location in its broad factors of financing, traffic, economic development, safety, roadside development and historical background. The first fourteen chapters, by Colonel Crosby, are entirely given up to those broad problems. In the second part Mr. Goodwin discusses mountain highway location in chapters on controlling factors, kinds of surveys, structural considerations and general design, followed by chapters on estimates and costs. The third part is a compilation by Colonel Crosby of parts of general instructions on location issued by state highway departments and of extracts from articles and papers by engineers, with comment and appraisal.

Teachers and students who have used one of the earlier editions of Professor Agg's book will find the present volume little changed in size and organization. The author has kept it a textbook on roads and streets. His only changes in the fourth edition have been those required to correct statements of practice to conform to the latest knowledge and experience, to give examples for practice and to strengthen the parts on design and economics. There is all through the text evidence of honest revision in form and presentation and contents.

As revised the book has 33 chapters, beginning with a review of the developments of highway systems and closing with four general chapters discussing the economics of roadway surfaces, selection of types of surfaces, general maintenance problems and road materials testing. Between are chapters on surveys, drainage, grades, rural highway design and street design, followed

by a chapter on each of the leading types of roads and pavements, proceeding from the simpler types to those involving the more complex design and construction problems.

Four Biographies With Portraits

EARLY COLUMBIA ENGINEERS, An Appreciation: John Stevens, 1768; James Renwick, 1807; Horatio Allen, 1823; Alfred W. Craven, 1829. [Prepared by J. K. Finch, Professor of Civil Engineering, for a group of Alumni of the Columbia Engineering Schools, in connection with the 175th Anniversary of Columbia University in the City of New York, October, 1929.] Boards, cloth back; 5x8 in.; pp. 42; with halftone portraits from paintings presented to the university by the Alumni Association of the Engineering Schools, "with the generous aid of descendants and friends." New York: Columbia University Press. $1.

It was a century ago that the latest and 161 years back that the earliest of these four notable engineers graduated from Columbia University. Besides his admirable sketches of each engineer Professor Finch sums up their careers in the following terse language: Stevens, "pioneer American mechanical engineer, inventor and railway transportation expert." Renwick, "author, scientist, engineer and expert advisor on most of the important problems of his time." Allen, "pioneer American canal, railroad and mechanical engineer." Craven, "after broad experience in early and important railroad, became chief engineer of the Croton Aqueduct Commission in 1849, a post he held for nineteen years." Allen was principal assistant engineer, under John B. Jervis, on the construction of the Croton aqueduct, completed in 1842, Jervis having succeeded Benjamin Wright. Craven was the fourth and Allen the fifth president of the American Society of Civil Engineers.

Besides his brief sketches of the lives of these four engineers, Professor Finch has provided a brief Introduction to his book in which he outlines the early history of engineering in America. Each of the sketches has a pictorial initial, appropriate to the engineer under consideration. The little book is a credit to all who joined in making it a possibility. The nominal price at which it may be obtained, combined with its merits, should give it a place in the thousands of engineering libraries.

Mental Byproducts of an Engineer

WAYS TO NATIONAL PROSPERITY AND OTHER ESSAYS; ADDRESSES AND REPORTS on Economics and Related Subjects—By C. E. Grunsky, Eng.D., Pres., Calif. Academy of Science, Past-Pres., A.S.C.E., Past-President, Pac. Div. Am. Assn. for the Adv. of Science. New York: Walter Neale, 37 East 28th St. Cloth; 5½x8 in.; pp. 165. $2.

The contents of this little volume fall into two groups: the occasional essay and travel notes. In the former group is the title address, Ways to National Prosperity, which may be summarized as a protest against curtailing public expenditures with little or nothing in mind except keeping down taxation. Many who will agree with Dr. Grunsky's main thesis will dissent from his arguments in support of heavy military and naval expenditures because, for the most part, as he argues, the money keeps men and factories producing food and other commodities. The author's plea for liberal expenditures for research work will doubtfully meet the approval of most engineers.

Other subjects treated in the general class of the occasional essay or address are the desirability of international congresses to obviate or lessen the urge for war; the commodity standard of value; farmers' problems, in which freight rebates at government expense are proposed; and taxation. In the latter the author seems to argue on the one hand against exempting incomes of various classes of public servants from the income tax and against exempting park and other public land from taxation, while on the other hand proposing that privately owned utilities be free from taxation.

The travel notes consist of observations—engineering economic, social and political—made during 1927 in the Near East, Greece, Italy, Austria, Paris and Germany, some of which were printed shortly afterward in *Engineering News-Record*. There is also included a report by Dr. Grunsky as delegate from the Institute of Consulting Engineers to the Stockholm Congress of the International Chamber of Commerce.

Weather Explained and Correlated

THE STORY OF THE WEATHER—By Eugene Van Cleef, Professor of Geography, Ohio State University. New York and London: The Century Co. Cloth; 5x7¾ in.; pp. 274; illustrated. $2.50.

Besides explaining weather in general, its elements and scientific methods of forecasting it, this clearly written book correlates the weather to the daily lives and problems of the individual, the household, the office and various branches of industry—that is, it has a notably human and business appeal.

Concrete Practice in France

LES DEFAUTS DES MORTIERS ET DES BETONS—Par J. Malette, Chef du Laboratoire de Chimie a l'Ecole Nationale des Ponts et Chaussees. Paris: Dunod, 92, Rue Bonaparte. Paper; 6¼x10 in.; pp. 226; 49 illustrations. Price in France: paper, 50 fr.; bound, 59 fr.

Troubles experienced in France because of the use of unsuitable materials and methods in concrete construction have brought forth this volume reviewing modern concrete practice, both plain and reinforced. The impression given by the author is that, aside from work done by the government and the large railways, concrete construction in France is still in a disorganized and empirical state; a condition which has, apparently, led to poor results and a consequent widespread distrust of concrete structures. The book under consideration has been written as a guide to better methods in the selection of materials, the mixing of concrete and methods of placing. Design is not touched upon. Separate chapters take up cementing materials, fine and coarse aggregates, mixing water, mortars and concretes of various types, testing, and supervision.

Within the scope indicated the treatment of the subject is excellent. The author draws largely on practice from other countries, including Italy, Germany, England and the United States. Suggested specifications are included for the proper regulation and inspection of concrete. While the book contains nothing unknown to American engineers, it is interesting by reason of its reflection of the state of the art in France.

Disease Carrier and Property Destroyer

THE RAT: A WORLD MENACE—By A. Moore Hogarth, F.E.S., with Preface by Sir Thomas Horder, Bart., K.C.V.O., M.D., F.R.C.P. London: John Bale, Sons & Danielsson, Ltd., 83-91, Great Tichfield St., W.1. Cloth; 5½x8¾ in.; pp. 112; illustrated. 7½s.

Billions of dollars of property are destroyed every year by rats and mice, if the estimate of a half-billion a year in Great Britain alone, given in this book, is approximately correct. Besides this, plague and other diseases are spread by the rat. These and other facts

and opinions regarding the world-wide menace to life and property are set forth in this little book—the object of which is to arouse appreciation of a major pest, an understanding of how to combat it, and both private and public action to that end. Besides giving an account of the rat in general, its geographical distribution, its fecundity, its waste of food and its role as a disease carrier, the book describes methods of "deratization," including large-scale corraling and destruction in rooms, flooding, smoking, ferreting, trapping, poisoning and use of cultures of virulent bacteria.

The Soul of a Corporation

FORTY YEARS WITH GENERAL ELECTRIC — By John T. Broderick, Author of "Pulling Together," etc. Albany: Fort Orange Press. Cloth; 5x8 in.; pp. 218; photographs and tables. $2.50 net.

Mr. Broderick interprets the historical development and present position of the General Electric Company in terms of the outstanding personalities that have been connected with it since its inception. He expresses the hope that the image formed in the reader's mind will not be a soulless corporation."

The first few chapters sketch the early growth of the company from its birth as the American Electric Company in New Britain, Conn., in 1880, to the dark days of 1893, when by a none too comfortable margin the young General Electric Company managed to keep afloat while the storm of financial panic raged all about it. Having dismissed the subject of the company's beginnings, Mr. Broderick turns to giving his impressions of the men whom he considers responsible for the tremendous subsequent development—financiers, managers, engineers and scientists, such as Coffin, Insull, Steinmetz and Langmuir. Of all these, the one to whom most space is given is Charles P. Steinmetz, and the brightest spot in the book is the record of a conversation with him on social and economic subjects.

Changes in Scottish Local Government

THE LOCAL GOVERNMENT (SCOTLAND) ACT, 1929—By W. E. Whyte, O.B.E., Solicitor, Clerk to the District Committee of the Middle Ward of Lanarkshire, author of "Local Government in Scotland," etc.; joint author of "The Law of Housing and Town Planning in Scotland, 1919-1925." Edinburgh and Glasgow: William Hodge & Co., Ltd. Cloth; 6x10 in.; pp. 332; 25 shillings.

Local government in Great Britain was materially changed by two acts of Parliament passed just before the Baldwin or Conservative administration went out early in 1929. One of the acts affects England and Wales; the other, Scotland. Each consolidates local government, largely by extending the powers of the counties, and each either cuts down or eliminates local taxation on agriculture and industry and shifts the burden to the nation.

The book before us first outlines the Scotland act and its significance, then presents the act in full with detailed comments. The act wipes out a thousand or more minor local governing bodies, including 869 parish councils. It transfers the powers of the parishes, and some of those of the smaller towns, to the county councils, which are reduced from 33 to 31 by uniting two pairs of councils for administrative purposes. Besides reducing the local rates (taxes) on certain railway property and on industrial plants the Scotland act cuts the rates on agricultural lands and dwellings to 25 per cent of normal.

The acts for both Scotland and England put into practice current opinion that minor local governments can no longer cope with the rapidly growing demands for all sorts of service and that, in Great Britain at least, they must have a constantly increasing amount of financial aid from the state—the total for England, Wales and Scotland will be some £45,000,000, or about $220,000,000, under the new acts.

Publications Received

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

ALEXANDER BOTTS: EARTHWORM TRACTORS—By William Hazlett Upson. New York: Farrar & Rhinehart, Inc. Cloth; 5x8 in.; pp. 289; colored pictorial end papers and dust jacket by Tony Sarg. $2.

DOMINION FUEL BOARD: Second Progress Report, 1923-28—Ottawa, Canada: Minister of Mines. Paper; 6x9 in.; pp. 57; illustrated.

MANUAL OF FIRST-ORDER LEVELING [A revision] — By Henry G. Ayres, Senior Mathematician, U. S. Coast & Geodetic Survey. Paper; 6x9 in.; pp. 93; illustrated. 30c. from Superintendent of Documents, Washington, D. C.

OHIO DEPARTMENT OF HEALTH: A Historical Review—By Charles A. Neal, M.D., Director of Health. Paper; 6x9 in.; pp. 15.

PONTES DO ETADO DE MINAS GERAES — By Francisco Sant'Anna, Inspector de Pontes, Rua Pernambuco, 881, Rio de Janeiro, Brazil. Paper; 7x11 in.; pp. 27 plus plates and tables.

Historical sketch, followed by brief descriptions of a considerable number of bridges; handsome halftone views and a few line drawings.

PRECAST CONCRETE FACTORY OPERATION — Containing Illustrated Descriptions of Typical Concrete Products and Cast Stone Factories, Together with a Chapter on Factory Design and Layout—By H. L. Childe, Editor, Concrete Publications Limited; author of "Manufacture and Uses of Concrete Products and Cast Stone." London: Concrete Publications, Ltd. 20 Dartmouth St., Westminster, S.W.1. Cloth; 5½x8½ in.; pp. 216; 146 halftones and line cuts. 3½ shillings.

STREET CLEANING AND REFUSE DISPOSAL in European Cities, with Suggestions Applicable to New York—By George A. Soper, M.Am.Soc.C.E. Report to the Committee of Twenty on Street and Outdoor Cleanliness Appointed by the New York Academy of Medicine, 2 E. 103d St. Paper; 6x9 in.; pp. 31; halftones.

Based on recent visits to 24 European cities in seven countries. Describes dustless refuse cans and wagon; street litter receptacles; incinerators, with recovery of salable refuse and utilization of heat to produce electricity. Suggests improvements in New York methods along lines of best European practice.

STRESSES IN RAILROAD TRACK, Special Committee on—Fifth Progress Report. Bulletin of the American Railway Engineering Association, Chicago: American Railway Engineering Association. Paper; 6x9 in.; pp. 272; 120 line cuts.

SYMPOSIUM ON PHYSICAL PROPERTIES OF CAST IRON—Authorized Reprint from 1929 *Proceedings*, American Society for Testing Materials, 1315 Spruce St., Philadelphia, Pa. Paper; 6x9 in.; pp. 118; illustrated.

WHO'S WHO IN CALIFORNIA: A Biographical Directory 1928-29, Being a History of California, as illustrated in the lives of the builders and defenders of the state, and of the men and women who are doing the work and molding the thought of the present time—Edited by Justice B. Detwiler and a staff of selected writers. San Francisco: Who's Who Publishing Co., 315 Montgomery St. Bound; 8x11 in.; pp. 720; illustrated.

In contents, follows the general line of State Who's Who, which in turn are like Who's Who in America, except that the state coverages include portraits and are far more inclusive than a national directory of notables can be. In arrangement, has the disadvantage of being thrown together without alphabetical order partly remedied by an index.

WIRTSCHAFTSFÜHRUNG UND FINANZWESEN BEI AMERIKANISCHEN EISENBAHNEN—Von Dr. jur. et rer. pol. Ludwig Homberger, Reichsbahndirektor und Mitglied der Hauptverwaltung der Deutschen Reichsbahn-Gesellschaft Ministerialrat a.D. Berlin: Deutschen Reichsbahn. Paper; 6x8 in.; pp. 103. 4.80 reichmarks.

A YEARBOOK OF RAILROAD INFORMATION—1929 Edition. New York: Committee on Public Relations of the Eastern Railroads, 143 Liberty St. Paper; 6x9 in.; pp. 94; diagrams.

Data on railroad plant and equipment, operating methods, rates, employees' wages and finances so presented by tables, diagrams and brief text that the performance of recent years can be compared with prewar conditions.

ZUR FRAGE DES PHENOLABWASSERS: Bericht über die Versuche der Emschergenossenschaft—Von Dr.-Ing. Max Pruss, Vorstand des Abwasseramtes der Emschergenossenschaft in Essen. Reprint from *Das Gas-Und Wasserfach*, August, 1929. Berlin and Munich: R. Oldenbourg. Paper; 8x12 in.; pp. 11; 9 illustrations.

Describes methods developed by the Emschergenossenschaft for treating the phenol wastes from byproduct coke plants, using artificial aeration, but concludes that cost involved renders them impractical of application on a large scale; also describes processes evolved for economically extracting the phenol from the crude ammonia liquor in the plant itself, thus eliminating the discharge of material containing phenol.

News of the Week

Hughes Reports to Supreme Court on Chicago Diversion

Nine-Year Program of Sewage-Works Construction Advised to Reduce Flow to 1,500 Sec.-Ft.

ACTING as a special master appointed by the U. S. Supreme Court, Charles Evans Hughes on Dec. 17 submitted a report to that body recommending that it order the construction in Chicago of a series of sewage-treatment plants over a period of nine years and the simultaneous reduction, by degrees, of water diversion from Lake Michigan from the present amount of 8,500 sec.-ft. to a permanent figure of 1,500 sec.-ft. on Dec. 31, 1938. The cost of this program is estimated at approximately $176,000,000. The report, prepared after hearing testimony from the city of Chicago and the Sanitary District of Chicago on the one side, and the states bordering the Great Lakes on the other, is the result of three separate suits initiated by the complainant states claiming that the diversion of water from Lake Michigan has had a detrimental effect upon navigation conditions.

Important recommendations are:

That the North Side sewage-treatment works, with appurtenances, should be completed on or before July 1, 1930.

That batteries A and B of the Imhoff tanks of the West Side sewage-treatment works should be completed on or before July 1, 1930.

That the Calumet sewage-treatment works, with appurtenances, should be completed on or before Dec. 31, 1933.

That the West Side sewage-treatment works, with appurtenances, should be completed on or before Dec. 31, 1935.

That the Southwest Side sewage-treatment works, with appurtenances, should be completed on or before Dec. 31, 1938.

That the necessary intercepting sewers pertaining to the above-described sewage-treatment works should be completed within the time allowed for the completion of the sewage-treatment works, respectively.

That in the foregoing estimate allowance is made for ordinary contingencies, but not for strikes or other occurrences beyond the control of the Sanitary District or its contractors.

That the diversion by the Sanitary District from Lake Michigan should be reduced on July 1, 1930, to an annual average diversion of 6,500 sec.-ft., in addition to domestic pumpage.

That, subject to the approval of the Secretary of War, upon the recommendation of the Chief of Engineers, controlling works should be constructed by the Sanitary District for the purpose of preventing reversals of the Chicago River at times of storm and the introduction of stormflow into Lake Michigan; that for this purpose the Sanitary District should immediately submit plans for such works to the Chief of Engineers of the War Department; and that such controlling works should be constructed by the Sanitary District within two years after receiving the authorization of the Secretary of War.

That when such controlling works have been constructed, the diversion by the Sanitary District of water from Lake Michigan should not exceed the annual average of 5,000 sec.-ft. in addition to domestic pumpage.

That there should be provision in the decree for an appropriate examination of results from time to time as the work of sewage treatment progresses, to the end that there may be such further reduction of the diversion by the Sanitary District as may be found to be feasible pending the completion of the sewage treatment works.

That, after the installation of controlling works as above provided, and on the completion of all the sewage-treatment works above described, and in the absence of competent action by Congress in relation to navigation law fully imposing a different requirement, the diversion by the Sanitary District of water from Lake Michigan should not exceed an annual average of 1,500 sec.-ft. in addition to domestic pumpage.

That by the term "diversion" in the foregoing conclusions is meant the flow diverted by the Sanitary District exclusive of the water drawn by the city of Chicago for water-supply purposes and entering the Chicago River and its branches or the Calumet River, or the Chicago Drainage Canal as sewage.

At the present time Chicago is drawing 8,500 sec.-ft. of water from Lake Michigan and sending this through the Chicago and Illinois rivers to be discharged down the Mississippi. This is being done under the authority of a War Department permit which expires Dec. 31, 1929. Application has been made for the extension of this permit, and it is believed that this will be granted pending a final ruling of the Supreme Court based upon the master's report.

Bond Sale Assures Purchase of San Francisco Water System

On Dec. 16 the San Francisco supervisors voted to accept the offer of the Bank of Italy to purchase $41,000,000 in bonds issued by the city in May, 1928, for the purchase of the Spring Valley water system to be used to distribute Hetch Hetchy water. The charter stipulates that city bonds cannot be sold for less than par, and as the Spring Valley bonds, at the rate of interest they bear, are not worth par on the present market the city has been unable to find a buyer. Under the plan adopted the city will redeposit the entire purchase price in the bank under adequate security, receiving 2 per cent interest until March 2, 1930, when the city will pay the Spring Valley company the full purchase price and take over the properties.

Flood-Control Work in Boeuf Basin Is Enjoined by Court

Operations Under Jadwin Plan Must Cease Until Property Owners Are Assured Compensation

FLOOD-CONTROL work in the Boeuf basin under the Jadwin plan is forbidden by a decision handed down this week by Judge Ben C. Dawkins, of the U. S. District Court, in a test suit brought by R. Foster Kincaid, a property owner. The plaintiff contended that the location of the levees and the construction of the fuseplug at the head of the floodway in Arkansas would materially affect the sale and mortgage value of his property, for which there has been no provision for compensation. Judge Dawkins held that an injunction should issue restraining operations until Kincaid was assured by the government that he would be reimbursed for any damages.

The decision was the first to be handed down in several test suits and affects more than a million acres of alluvial lands in northeast Louisiana and southeast Arkansas. It indirectly affects all property owners who might claim compensation for land damaged as a result of the Jadwin plan of flood control.

Government Is Responsible

"When the government departed from the policy of building levees and other public works for the purpose of commerce and navigation alone and expressly entered the field of controlling floods for the protection and reclamation of private lands, then it became engaged in activities which make it responsible for the invasion of private rights," Judge Dawkins said in his opinion.

"It will not be assumed," the opinion continued, "that Congress intended to violate the Fifth Amendment to the Constitution by taking private property for public purposes without just compensation.

"There is a universally recognized principle that the owner of property subject to overflow waters of either navigable or non-navigable streams is entitled to have them to continue in their natural state without burden or hindrance imposed by artificial means, and no public easement beyond the natural can arise without grant or dedication, save by condemnation with appropriate compensation for the private right.

"I think it reasonably clear that when the plan is completed the property

within the floodways can be cultivated in most years. But always, of course, with the knowledge that a flood may come and cause owners or operators to suffer serious loss. However, there are elements going into the amount or value to be paid for the rights, for the act clearly indicates that the government may acquire, either in fee simple the lands desired or merely a right of flowage in these cases where nothing more is needed.

"The act provides that when the Secretary of War wishes to acquire any lands, easements or rights of way needed in carrying out this project, he shall institute proceedings in the United States District Court where the same is situated, if unable to agree with the owners as to the price."

At the taking of testimony in the suit (see *Engineering News-Record*, Oct. 24, 1929, p. 668) government engineers minimized the damage that might be caused as the result of the floodway, but rigid cross-examination brought out the fact that the water levels during flood stages would be considerably higher.

Committee Named to Carry On Work of Business Stabilization

Formation of the smaller of the two executive committees to be formed following the business stabilization conferences recently held in Washington has been announced by Julius H. Barnes of the U. S. Chamber of Commerce, chairman of the committee. The list contains twenty names, not including the chairman. Members of a larger committee, also authorized by the conference, will be named later to serve as contact men between the executive committee and trade associations and commercial groups. The small committee will be called into consultation at an early date. Its membership is as follows:

Owen D. Young, chairman of the board, General Electric Company and Radio Corporation of America, New York City; Myron C. Taylor, chairman, finance committee, United States Steel Corporation, New York City; Thomas W. Lamont, J. P. Morgan & Company, New York City; Paul Shoup, president, Southern Pacific Company, San Francisco, Calif.; Clarence M. Woolley, chairman of the board, American Radiator & Standard Sanitary Corporation, New York City; Henry M. Robinson, president, Los Angeles-First National Trust and Savings Bank, Los Angeles, Calif.; Walter C. Teagle, president, Standard Oil Company of New Jersey, New York City; James Simpson, president, Marshall Field & Company, Chicago, Ill.; Cornelius F. Kelley, president, Anaconda Copper Mining Company, New York City; Elbert L. Carpenter, president, National Lumber Manufacturers Association, Minneapolis, Minn.; Pierre S. du Pont, chairman of the board, E. I. du Pont de Nemours & Company, Wilmington, Del.; Lewis E. Pierson, chairman of the board, Irving Trust Company, New York City; George Horace Lorimer, editor, *Saturday Evening Post*, Philadelphia, Pa.; Walter S. Gifford, president, American Telephone & Telegraph Company, New York City; Alvan Macauley, president, National Automobile Chamber of Commerce, Detroit, Mich.; John G. Lonsdale, president, American Bankers Association, St. Louis, Mo.; Stuart W. Cramer, director, Cotton Textile Institute, Cramerton, N. C.; Charles Cheney, president, National Industrial Conference Board, Manchester, Conn.; Silas H. Strawn, chairman of the board, Montgomery Ward & Company, Chicago, Ill.; Harry Chandler, publisher, *Times*, Los Angeles, Calif.

STUDYING THE COLORADO RIVER AQUEDUCT

The board of review appointed by the Metropolitan Water District, composed of Los Angeles and near-by cities, is at work on the task of selecting from the 56 officially proposed routes the best location for the aqueduct line from the Colorado River to southern California. From left to right: A. J. Wiley, F. E. Weymouth, chief engineer of the district, Thaddeus Merriman, and Richard R. Lyman. Several months will be required before any decision is expected as to the best route for this project, which is estimated to cost more than $200,000,000.

South Carolina Road Bond Issue Taken to U. S. Supreme Court

By a writ of error issued Dec. 10 the question of the constitutionality of the proposed $65,000,000 road bond issue of the State of South Carolina has been taken to the U. S. Supreme Court for decision. The bond issue is attacked on the ground that it was not submitted in an election to the qualified voters of the state for their approval.

Bids for the first block of $10,000,000 worth of bonds were called for Dec. 17. Despite the appeal, one offer was received, but this was rejected on the ground that better offers would probably be received after the litigation had been settled. A review of plans for the expansion of South Carolina's highways to be financed by the bond issue was given in *Engineering News-Record*, Oct. 17, 1929, p. 631.

Water Shortage in Northwest Relieved by Rains

Several days of rain and snow have broken the drought in the Northwest, including British Columbia, and brought relief from what was rapidly becoming a serious water and power shortage. Snow is also reported in the California Sierras, and a general rainfall in northern California has broken the drought there. Although the power companies of California were not facing a power shortage, the rain has come at an opportune time to augment a rapidly decreasing water supply, greatly to the relief of farmers and stock raisers.

Secretary of the Navy Adams on Dec. 12 sent a despatch to the Mayor of Tacoma, Wash., stating that the Navy Department is willing to detail the aircraft carrier "Lexington," now at Seattle, to supply electric current to the city of Tacoma during the present emergency for a period not in excess of 30 days. In view of the recent precipitation, however, use of the vessel will probably be unnecessary.

Western Society Promotes Its Secretary

To give a somewhat more distinctive title to its executive officer in dealing with the larger concerns and problems of the society outside of his secretarial duties, the Western Society of Engineers has given the title of director and secretary to Edgar S. Nethercut, who has been secretary since June, 1917.

High Suspension Bridge Opened in Colorado

At an elaborate ceremony attended by a large number of people, the Royal Gorge bridge across the Arkansas River 9 miles from Cañon City, Colo., was dedicated Dec. 8. The bridge, said to be the highest suspension span in the world, is approximately 1,050 ft. above the streambed at the foot of the canyon. Its total length is 1,250 ft., and its main span across the Royal Gorge 880 ft. It was built for the Royal Gorge River & Amusement Company. Immediately after dedication exercises the bridge was opened to pedestrian and automobile traffic.

New Jersey High-Level Bridge Plans Approved

Approval has been given by the U. S. War Department to the revised plans submitted by the State of New Jersey for the construction of two cantilever bridges across the Hackensack and Passaic rivers as part of a new diagonal express highway between Jersey City and Newark, N. J. The two structures will be duplicates with clear spans of 550 ft. and clearances of 135 ft. above mean high water. They will be connected by a viaduct carrying through vehicular traffic between New York City and the west. The entire highway project will cost about $20,000,000.

Union Pacific Ordered to Build New Line in Oregon

Railroad extension involving an estimated cost of $9,908,000 was ordered by the Interstate Commerce Commission on Dec. 13 when it directed the Union Pacific Railroad and its subsidiaries, the Oregon Short Line and the Oregon-Washington Railroad & Navigation Company, to construct a 185-mile line in Oregon to connect with the Southern Pacific system. The new line is for the purpose of providing rail facilities for the rich but sparsely settled region in the foothills of the Cascade Mountains, and will connect a rail-head of the Oregon Short Line near Crane, Ore., with the Cascade Line of the Southern Pacific at Crescent Lake, Ore. The application for the order was filed with the commission by the Public Service Commission of Oregon, and the case was vigorously contested by the Union Pacific and its subsidiaries.

As this is the first decision ever handed down by the commission ordering a railroad to undertake a major rail construction project against its will, and because of the fundamental principles involved, the case is expected to be taken to the courts for a review of the commission's decision. In support of its position claiming authority to order such an extension, the commission cites paragraph 21, of Sec. 1, of the interstate commerce act, which provides:

The commission may, after hearing, in a proceeding upon complaint or upon its own initiative without complaint, authorize or require by order any carrier by railroad subject to this act, party to such proceeding, to provide itself with safe and adequate facilities for performing as a common carrier its car service as that term is used in this act, and to extend its line or lines; provided that no such authorization or order shall be made unless the commission finds, as to such extension, that it is reasonably required in the interest of public convenience and necessity, or as to such extension or facilities that the expense involved therein will not impair the ability of the carrier to perform its duty to the public.

In a dissenting decision, Commissioner Brainerd cited a statement of Chief Justice Taft incident to the Los Angeles passenger terminal case, recently decided by the Supreme Court, in which he said:

If Congress had intended to give an executive tribunal unfettered capacity for requisitioning investment of capital of the carriers and the purchase of large quantities of land and material in an adverse proceeding, we may well be confident that Congress would have made its meaning far clearer and more direct than in the present meager provisions of the transportation act.

Army Engineers' Work Detailed in Report for Fiscal Year 1929

Final Report Under Jadwin Leadership Reviews Expenditures and Lists Further Work Necessary

IN ADDITION to accounting in detail for the expenditures made during the fiscal year 1928-29, the report of Major-Gen. Edgar Jadwin, Chief of Engineers, U. S. Army, recently made public, lists the allotments made to the different projects from money appropriated by Congress on Feb. 28, 1929, and makes recommendations for appropriations during the fiscal year 1930-31. A brief summary of the amounts involved in the three periods are given in the table below:

Major Projects Included in Chief of Engineers' Report	Expenditures 1928-1929	Available for Expenditure 1929-1930	Recommended Appropriation 1930-1931
River and harbor improvements	$50,156,454	$50,000,000*	$55,000,000
Mississippi flood control	24,556,104	30,800,000*	35,800,000
Sacramento River flood control	497,293	1,000,000	1,000,000
Miscellaneous classifications	7,736,011	11,358,876	288,000
Total	$82,945,862	$93,158,876	$92,088,000

*Exclusive of balances from earlier appropriations.

Of the $50,000,000 appropriated by Congress for river and harbor improvements for the current year, the largest allotments are as follows:

Delaware River, Philadelphia to sea	$3,000,000
Missouri River	7,300,000
Mississippi River	5,175,000
Ohio River	2,569,000

In addition to the above allotments, the Missouri River project has been granted $2,000,000, and the Delaware River project $1,184,000 from the unallotted balance from the previous years' appropriations.

Of the $30,800,000 available for expenditure for Mississippi flood control, $800,000 is an emergency fund for flood control on Mississippi tributaries, and of the balance, $23,794,680 has been distributed by the Mississippi River Commission as follows:

President's office	$250,000
St. Louis Engineer office	2,000
Rock Island Engineer office	22,680
Memphis Engineer District	8,367,500
Vicksburg Engineer District	7,610,000
New Orleans River District	7,842,500
Total	$23,794,680

The amount necessary to carry to completion the projects now under way is $216,444,110 for rivers and harbors, and $291,660,000 for flood control.

The plan adopted for the protection of the alluvial valley of the Mississippi comprises the raising of the existing levees by 3 ft. and strengthening them greatly, and the construction of spillways and floodways to carry off to the Gulf the excess over the safe capacity of the leveed channel. The plan also calls for the revetting of the banks of the river for the purpose of stabilizing its course. The Mississippi River Commission recommends that the project be carried on at a rate of expenditure of $35,000,000 yearly.

Large Hydro-Electric Power Project Begun in Canada

The Stuart Cameron Company, Ltd., of Vancouver, B. C., will build the first 17,000-hp. unit of the hydro-electric power project being developed by the Powell River Company. Contract was recently awarded at a figure approximating $2,000,000. The development is to be on the Lois River, a tributary of the Powell River. It will comprise a storage dam on the Lois River, 12 miles from the town of Powell River, several sections of pipe line, a tunnel more than a mile long and the power house on the Lois River. In addition, the contracting company will install machinery for the enlarged pulp and paper factory of the Powell River Company. A power transmission line from the projected plant to the town has already been commenced, and will cost approximately $150,000. It is expected the first unit will be completed by the end of 1930. The ultimate development of the Lois River at this point is estimated at 35,500 hp.

War Department Presents Report on Engineering Activities

In his annual report for the fiscal year ended June 30, 1929, the Secretary of War reviews the engineering activities of his department, including the operation of the Panama Canal and the maintenance and improvement of internal waterways.

Total transits of the Panama Canal amounted to 7,029 vessels during the year. Tolls amounting to $27,128,889 were collected, and 30,663,006 tons of cargo was carried. The Seventieth Congress authorized a survey to determine the additional facilities needed at the canal, and also an investigation and survey of the Nicaragua Canal route. The Governor of the Panama Canal has been directed to make the necessary survey with reference to the Panama Canal. A battalion of engineers, organized especially for the work contemplated, is now in Nicaragua organizing the work in that country.

Appropriations for the civil works administered by the Corps of Engineers for the fiscal year 1929 totaled $101,002,376. During the year expenditures have been made on the basis of 40.8 per cent for contract work, 27.2 per cent for materials, and 32 per cent for hired labor. The work done by the department in the improvement of rivers and harbors covers maintenance and improvement operations in 930 localities. The total Wilson dam project, at Muscle Shoals, Ala., has been practically completed at a cost of $46,864,404. Receipts from the sale of power generated during the fiscal year were $2,639,608 and the total operating expenses were $750,814. The total commercial traffic on internal waterways of the country during the calendar year 1928 amounted to 529,500,000 tons, valued at $24,160,000,000.

New York Central to Relocate Tracks in New York City

The New York Central Railroad Company has been authorized by the Interstate Commerce Commission to abandon its present freight tracks on the west side of Manhattan Island, New York City, incident to a relocation that will eliminate grade crossings. The relocation involves abandonment of the freight terminal in St. Johns Park, near the southern end of the present line; abandonment of all the double-track line laid at grade, as far north as 60th St.; extensive improvements and enlargements of the yard located between 30th and 33d Sts.; construction of a new double-track viaduct, located largely on private right-of-way, just west of the present tracks, as far north as the 30th St. yard; construction of a new five-track line, below street grade, from the yard to 60th St. No track improvements are contemplated above 60th St.

The change at the 30th St. yard from overhead to underground construction will be effected by means of a loop, skirting the yard on the south, west and north sides. Operation on the relocated lines will be by electricity north of the yard, and by diesel locomotives in the yard and on the viaduct to the south. The entire project will involve an expenditure of $138,737,500, of which $120,872,000 will be borne by the railroad and the remainder by the state and city. This estimate of cost includes $23,073,030 to be used for new electric power facilities and for the purchase of 30 or 35 diesel locomotives. The program contemplates the removal of all tracks from the streets within five years.

The Business Outlook

We feel that, so far as industrial activity is concerned, the worst will be over in the next six weeks. Money rates will probably be kept down till well into next year; but the banks will be under some strain to carry their large burden of weak security holdings and slow-moving inventories, and February or March will probably see some dust raised in the stock market by their spring cleaning of weak security accounts. Steel ingot production is down to about 64 per cent, compared with 67 per cent last week and 82 per cent a year ago. November automobile production in the United States and Canada fell to 214,400 from the October figure of 394,400, and 268,900 for last November.
—The Business Week, Dec. 18.

No Recovery for Incidental Losses From Levee Break

The Supreme Court of Louisiana has decided in favor of the Orleans Parish Levee Board in two test cases brought by persons who sought to make the board liable for loss of wages sustained by them as a consequence of the cutting of the Caernarvon levee in April, 1927. The levee board contended that it was liable for destruction of or damage to physical property only and this contention is upheld by the Supreme Court.

Several hundred similar claims will now be thrown out. These are said to involve more than a million dollars, from lost wages, lost revenues of small businesses, and loss of revenues from trapping lands.

New Application Filed for Bridge at New Orleans

On Dec. 12 the Board of Commissioners of the Port of New Orleans approved a new application by George A. Hero and Allen S. Hackett for the construction of a bridge over the Mississippi River from the head of Race St. to Gretna on the west bank. This application, based on various structural changes, has been filed with the Secretary of War. The following changes are shown: Vertical clearance in center to be 170 ft. at high water as compared with 160 ft. originally proposed; minimum clearance for center width of 750 ft. to be 166 ft. instead of 152; minimum clearance for the 1,760 ft. between piers to be 149 ft. instead of 135; pier on the east bank to be within the wharf line.

Illinois Contractors Told of New Highway Specifications

New highway specifications, prequalification of contractors, fair trade practices and economics of the industry were the principal topics discussed at the 23d annual convention of the Illinois Association of State Highway and Municipal Contractors, Dec. 11-13 at Chicago. Following the address of the president, Alan Jay Parrish, who spoke of unsatisfactory bidding and competitive conditions among Illinois contractors, the subject of revised state highway specifications was discussed by Frank T. Sheets, chief highway engineer of Illinois. Revision has been in progress for eighteen months, with extensive consultation of contractors, and the resulting document will go to the printer early next year. The major changes refer to proportioning concrete by weight; payment of one price for piles delivered and another sum for those driven; a more easily understood and interpreted classification of earth; a stricter requirement for earth consolidation on fills (fills less than 4 ft. deep compacted in 9-in. layers; fills 4 to 6 ft. puddled, and fills above 6 ft. placed in 18-in. layers). Illinois hopes to be in the market for roads early in February with $25,000,000 available for new construction—if the gas tax law is upheld.

Prequalification of contractors was touched upon by several speakers. Mayor Charles Bartlett, Evanston, Ill., indicated that the cities' viewpoint is wholly favorable to the idea. He explained a questionnaire which the city has used with good results, although it has no legal basis.

S. M. Williams, manager, engineering construction division, Associated General Contractors, outlined the progress of the newly formed Bureau of Contract Information which was set up and financed to the extent of $35,000 by the 35 surety companies now in the bureau. Reports indicate that last year contracts amounting to $4,000,000 were let at lower figures than the engineers' estimates. This year still more work has been let on this low basis. The contractors, he stated, lack backbone in cleaning up the situation. Records have been received from 1,160 contractors (of which 800 have been verified), from 6,533 public officials, architects and engineers, 1,674 banks, 5,785 manufacturers and 641 distributors. The bureau has listed about 25,000 contractors in the country. Contracts let in *Engineering News-Record* for 1928 and 1929 are being tabulated and those not reported to the bureau are to be investigated.

Prof. Charles M. Thompson, dean of

the college of commerce, University of Illinois, stated that in no other industry is capital "frozen" so quickly and in such amounts as in the construction field. His further views are as follows: Some of this capital is permanently frozen or fixed in the shape of the monumental type of public works. For stability proper relation must exist between the frozen capital and that which is fluid and flows back into the hands of the people producing buying power. An unbalanced ratio is our present difficulty. Attempts to correct it by an undue stimulation of public works will be equally prejudicial toward stability of prosperity. Therefore this way out must not be made too easy.

Public Construction Work Expedited, Survey Shows

A preliminary survey by the new division of public construction, just created in the Department of Commerce at the request of President Hoover, reveals widespread, prompt and efficient mobilization of effort to expedite public construction, in response to President Hoover's appeal for the co-operation on the part of Governors and other public officials.

The newly organized division, which is under the direction of Dr. John M. Gries, of Ohio, former chief of the division of building and housing of the Department of Commerce, serves as a clearing house of information on methods and plans. In general, it is helping to co-ordinate the efforts of the federal government departments and of state and local governments in their programs to help to stabilize business and employment conditions by speeding up construction projects. The new unit is also making an intensive study of federal government projects now under way or which can yet be put in motion within the next few months.

Western State Engineers Meet at Reno, Nev.

Representatives of nine states met in Reno, Nev., Dec. 9 for the second annual conference of the Association of Western State Engineers. The three-day program was outlined by subjects in *Engineering News-Record*, Nov. 21, 1929, p. 828. States represented at the meeting were Oregon, Idaho, California, Nevada, Colorado, Utah, Kansas, Wyoming and North Dakota.

A major portion of the discussion centered about the question of whether the federal government or the several states should have the right to control the unappropriated, unnavigable waters within state boundaries. While recognizing the need for federal control in interstate cases, there are many situations in which there is conflict of authority, and endeavor was made to direct discussion toward some generally workable control plan that would aid in administering water rights. Specific legislation hardly can be expected, it was pointed out, until such action can be based on wide experience in practical problems of water administration. One of the ramifications of the water rights problem is the difficulty of distinguishing between return flow and natural flow, particularly in cases where storage is involved.

Denver was selected as the place for the next annual meeting, and M. C. Hinderlider, Colorado state engineer, was elected president for the ensuing year. The secretary for the ensuing term is to be appointed by Mr. Hinderlider from his own staff.

Brief News

CONCRETE ROAD CONSTRUCTION is increasing in Germany. The construction program for 1930 includes about 1,000 km. of this type.

NEW YORK CITY'S BUDGET for 1930 has been passed by the Board of Aldermen. It carries a total of $564,769,828.23.

TWIN CONCRETE CHIMNEYS completed recently in Germany have heights of 459 ft., with widths tapering from 39 ft. at the bases to 20 ft. at the tops.

REQUIREMENTS FOR BUILDING EXITS have been standardized in a code recently approved by the American Standards Association and made available for adoption by state and municipal authorities.

STEEL GIRDER CONSTRUCTION is to be used in a bridge soon to be constructed across the River Elbe near Dresden, Germany. A central span of 377 ft. will be flanked by two spans of 223 ft. and one of 131 ft.

MINIMUM PAY for Baltimore's per diem employees has been fixed at 45c. an hour by an ordinance passed by the city council. The ordinance is a compromise, one having been introduced some time ago providing for a 50c. minimum.

NEW BESSEMER and open-hearth furnaces are included in a $10,000,000 improvement program for the lower works of the Cambria plant of the Bethlehem Steel Corporation, Johnstown, Pa. which has just been announced. This follows closely the completion of a $12,000,000 improvement program at the same plant.

CONSTRUCTION OF A 112-FT. WATER TOWER in the Jamaica section of the Borough of Queens, New York City, has been temporarily enjoined on the grounds that it would be an eyesore and a nuisance to near-by residents. A hearing has been set for Jan. 29.

BLAST-FURNACE SLAG will be the primary material used in the manufacture of paving brick and vitrified pipe at a new plant now under construction near Duisburg, Germany, which will have a daily capacity of 1,500 tons.

ITALY'S PUBLIC WORKS PROGRAM for the year ending Oct. 28, 1930, includes 3,657 individual improvement jobs, to cost approximately $196,800,000. Road work is distributed over the country in 2,660 jobs amounting to nearly $40,000,000.

THE TIME LIMIT for the work of changing the course of the south branch of the Chicago River between Polk and 19th Sts., Chicago, and for filling in part of the old channel has been extended by the War Department to Dec. 31, 1931.

IMPROVEMENT AND BEAUTIFICATION of the north side of Washington Channel, D. C., at a cost of $3,691,000 has been recommended by Major-Gen. Lytle Brown, Chief of Engineers. The cost would be divided between the federal and district governments, and would be amortized through the collection of rentals for piers and slips.

THE COMMISSION-MANAGER plan of government was adopted by the voters of Flint, Mich., in a recent referendum, by a vote of 5,187 to 3,814, about 16 per cent of the electors voting. Effective next March, there will be nine commissioners at a salary of $500 yearly each in place of the present mayor and fourteen aldermen.

STRICTER ENFORCEMENT of the engineering registration law is planned by the South Carolina State Board of Engineering Examiners, which has instructed its secretary to write all county officials and others who are now using the title of engineer but who are not registered according to law.

DRAINAGE AND FLOOD CONTROL programs for Birmingham, Ala., have been presented in a report submitted by City Engineer Hawkins, who recommends the issue of $3,000,000 in bonds to finance preliminary work on Village Creek and Valley Creek within the city limits. Eventually it will be necessary to increase expenditures to a total of $7,825,362, according to the plans submitted.

THE FEDERAL POWER COMMISSION has approved the amendment of the license of the Pacific Gas & Electric Company, covering its project on the Mokelumne River in California. Under the amendment the company will increase the storage capacity of its Salt Springs reservoir. The height of the dam will be increased so that 70,000 acre-ft. will be added to the storage. An additional power plant is to be installed at Salt Springs dam and the installation at Tiger Creek is to be increased to 70,000 hp.

EXPANSION OF THE PRINCIPAL HYDRO-ELECTRIC STATION supplying Victoria, B. C., is provided for in two contracts recently awarded by the British Columbia Electric Railway Company. The Vancouver Engineering Works, Ltd., will construct a 60-in. steel penstock approximately 2 miles long at a cost of $387,000. The English Electric Company, of London, England, will supply a 14,000-kw. generator for $90,000 and an 18,000-hp. waterwheel for $70,000. Both units are to be installed next summer.

Personal Notes

FRANK S. KNITTLE has been appointed city engineer of Casper, Wyo.

W. F. RECH, bridge engineer of the Chicago & Alton Railroad at Chicago, has resigned.

HERBERT GWINNUP, of Indianapolis, has been appointed city engineer of Anderson, Ind., by the incoming mayor.

H. D. PALMORE has been appointed Kentucky state highway engineer, succeeding J. S. WATKINS, who recently resigned.

L. G. WHITNEY, of Westerville, Ohio, has been elected city manager of Piqua, Ohio, by the city commission. Mr. Whitney is a civil engineer.

E. L. HEISER has been advanced to the position of maintenance superintendent in the Oklahoma highway department, succeeding L. H. Stewart, resigned.

W. M. JARVIS, engineer of maintenance, and J. D. NILES EVANS, engineer of equipment, both in the Kentucky state highway department, have resigned.

LYSANDER E. WRIGHT, who has been engaged for the past three years as designer and engineer of the incinerator plant at Paterson, N. J., has tendered his resignation, effective Dec. 16.

ROBERT RIDGWAY, of New York, has been decorated by Japan with the Third Order of Rising Sun in recognition of his advisory services in connection with construction of Japanese railway tunnels.

FRANK L. HALE has resigned as vice-president and general business manager in charge of airport construction of the Curtiss Flying Service to become vice-president of the John H. French Company, airport contractors and engineers.

A. W. BROWN, of Portsmouth, has been appointed full-time resident engineer for Ross County, Ohio, and H. WILSON HUNTER, at present deputy to the county surveyor of Ross County, has been made resident engineer in the Ohio highway department.

ARMSTRONG CHINN, engineer of maintenance-of-way of the Chicago, Burlington & Quincy Railroad at Lincoln, Neb., has been appointed chief engineer of the Chicago & Alton Railroad, with headquarters at Chicago. He succeeds R. A. COOK, who has resigned.

E. W. NEELANDS, of New Liskeard, Ont., has been appointed chief engineer of roads for Newfoundland and will take up his new duties in the spring in connection with an extensive program of road construction which is being planned.

W. H. GEHRING, of Edwardsville, Ill., has been appointed superintendent of maintenance for about 200 miles of hard roads in Madison, Macoupin and Montgomery counties under the Illinois Division of Highways. He will work under C. M. Slaymaker, division engineer at East St. Louis, Ill. He succeeds T. W. LAWRENCE, of Carlinville, Ill.

S. A. BLOK, a civil engineer of the Dutch East Indies, has been making an inspection and study of earthfilled dams as constructed in the United States. He recently visited Denver, Colo., where he discussed the matter with the U. S. Reclamation Bureau's engineers.

GEORGE A. SOMMERVILLE, assistant district engineer in District No. 5 of the Illinois Division of Highways with headquarters in Paris, Ill., has succeeded Lloyd Schwartz as district engineer for District No. 9 at Carbondale, Ill. Mr Schwartz was drowned in the Mississippi River a month ago.

W. B. WOOD, an engineer for the Pennsylvania Railroad, has arrived in Baltimore from Chicago and taken charge of the company's new tunnel and terminal project which will be carried out in Baltimore. The work will cost about $22,500,000. Mr. Wood will assemble his staff soon after the first of the year.

WILLIAM S. LEE, vice-president and chief engineer of the Duke Power Company, Charlotte, N. C., has been nominated president of the American Institute of Electrical Engineers. Mr. Lee is also a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Engineering Institute of Canada and the American Engineering Council.

Obituary

W. M. GAUM, 31 years old, a civil engineer for Ward & Hayes, contractors on levee construction at Cairo, Ill., died in a Cairo hospital Dec. 9 from injuries received the day previous when his automobile collided with a street car.

JOHN H. FETTERMAN, of Pittsburgh, Pa., head of the J. H. Fetterman Engineering & Construction Company, dropped dead in his office on Dec. 10. He was 50 years old and had been a construction operator in Pittsburgh for twelve years.

L. A. DUNCAN, engineer for Dobson & Humphreys, of Omaha, Neb., is dead in Houston, Miss., following an illness of more than a month. Mr. Duncan was carrying out a sewerage contract his firm had with the city. He was 50 years old.

PETER F. BRENDLINGER, formerly chief engineer of the Schuylkill Valley Division of the Pennsylvania Railroad, died in Philadelphia Dec. 16, aged 79. Mr. Brendlinger built the Point bridge in Pittsburgh and while associated with Brown, Howard & Company, of New York, aided in the construction of the Croton aqueduct.

J. F. CASE, head of the Paris office of Stone & Webster, died Dec. 14 in New York City of heart disease. After his graduation from the University of Wisconsin in 1890, Mr. Case went to Oregon in connection with the construction of railroads. He served in the Philippines during the Spanish War and after the war was instrumental in the renovation and deepening of Manila harbor and in the construction of the drainage system of Manila. In 1908 he became director of public works of that city. Later he became vice-president and general manager of the Cuban Engineering & Construction Company, which put in the drainage system of Havana. In 1916 he joined the staff of the American International Corporation and was sent to Spain and later to Italy to report on engineering projects. He afterward joined Ulen & Company and helped in the negotiations for the construction of the water-works of Athens, and was delegated by the League of Nations to report on the transportation system of Poland. Two years ago he was made head of the Paris office of Stone & Webster, Inc.

Society Calendar

AMERICAN CONCRETE INSTITUTE, Detroit; annual convention, New Orleans, La., Feb. 11-13.

AMERICAN ROAD BUILDERS ASSOCIATION, Washington; annual convention, Atlantic City, N. J., Jan. 11-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; annual meeting, New York City, Jan. 15-17.

AMERICAN WOOD PRESERVERS ASSOCIATION, Chicago; annual meeting, Seattle, Wash., Jan. 28-30.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington; annual convention, New Orleans, La., Jan. 20-22.

ASSOCIATION OF HIGHWAY OFFICIALS OF NORTH ATLANTIC STATES, Trenton; annual convention, Syracuse, N. Y., Feb. 19-21.

NATIONAL CRUSHED STONE ASSOCIATION, Washington; annual convention, Cincinnati, Ohio, Jan. 20-23.

NATIONAL SAND AND GRAVEL ASSOCIATION, Washington; annual meeting, Memphis, Tenn., Jan. 28-30.

CHATTANOOGA ENGINEERS CLUB on Dec. 2 elected officers as follows: president, J. W. Edwards, University of Chattanooga; vice-presidents, C. A. Betts and Donald Munson; secretary, O. F. Reynolds; treasurer, J. A. Fairleigh.

LAND RECLAMATION DIVISION, American Society of Agricultural Engineers, will hold a meeting Dec. 30-31 at Kansas City, Mo., at which discussion will be held on the subjects of land erosion control, drainage, irrigation and land clearing.

NEW YORK SECTION, American Water Works Association, will hold its regular midwinter luncheon meeting Dec. 27. The program includes addresses by George A. Cooper, of the U. S. Bureau of Standards, and George A. Fuller, consulting engineer. A director to represent the section on the board of direction of the parent society will be elected.

NORTHWEST BRANCH, Associated General Contractors, will hold its eleventh annual convention Jan. 6-8 at Minneapolis.

TEXAS ASSOCIATION OF SANITARIANS in convention at Edinburg, Tex., Nov. 5, 1929, selected the following new officers for the year 1930: president, H. K. Read, Houston; vice-presidents, H. W. Van Hovenberg, Texarkana, Y. J. Aiken, Lubbock, C. N. Shepherdson, College Station, and Marguerite Cunningham, Fort Worth; secretary, E. G. Eggert, Austin. It was unanimously decided to hold the 1930 annual short school at Amarillo the first part of September and also to hold the business session jointly with the American Public Health Association convention, with which the Texas Association is affiliated, at Fort Worth the last week in October.

Construction Equipment and Materials

Mergers Form Third Largest Steel Company

Ratification of a merger agreement by the boards of directors of the Republic Iron & Steel Company, the Central Alloy Steel Corporation, Donner Steel, Inc., and the Bourne-Fuller Company has resulted in the formation of a $350,000,000 corporation to be known as the Republic Steel Company, which will be exceeded in size only by the United States Steel Corporation and the Bethlehem Steel Corporation. The new company will link steel producers in Ohio, Illinois, Michigan, Alabama, New York and Pennsylvania and will control fourteen blast furnaces, 65 open-hearth furnaces, six electric furnaces, 633 coke ovens, seventeen rolling mills and 158 finishing mills. Raw material reserves include 125,000,000 tons of iron ore, 165,000,000 tons of coal and 30,000,000 tons of limestone and dolomite. Special processes controlled by the company include the electric welding of pipe, the Withero patents for die rolling and the American rights for producing Nitalloy and Nirosta steel.

Officers of the new company include Tom M. Girdler, recently resigned from the Jones & Laughlin Steel Corporation, who will be chairman of the board; and Elmer T. McCleary, president of the Republic Iron & Steel Company, who will be president.

Concrete Pavement Yardage

There is given below a tabulation of concrete pavement yardage awarded during the month of November, 1929, and also the total number of square yards awarded for roads, streets and alleys in the United States for the year 1929 to date as of Nov. 30:

	Sq.Yd. Awarded During November, 1929	Sq.Yd Awarded From Jan. 1, 1929 to Nov. 30, 1929
Roads	3,207,275	87,510,164
Streets	1,721,705	41,139,921
Alleys	428,639	3,551,428
Totals	5,357,619	132,201,513

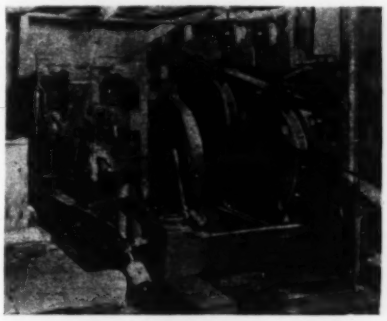
U. S. Steel Buys Atlas Cement

Acquisition of the outstanding stock, assets and good will of the Atlas Portland Cement Company by the United States Steel Corporation has been announced in a letter to stockholders of the former company signed by John R. Morron, president of the Atlas company, informing them of the terms of the exchange of stock by which the transfer is to be made. A special meeting of the stockholders has been called for Dec. 28 for the purpose of ratifying the transaction, but it is understood that this is merely a formality, for the letter states that a majority of the Atlas stockholders have already approved and that the board of directors has voted to accept the exchange offer. The U. S. Steel Corporation already owns the Universal Portland Cement Company, a large producer of cement.

New Developments

Automatic Brakes Safeguard High-Speed Hoist

To minimize the number of accidents resulting from the dropping of loads, especially in congested districts, the Lidgerwood Manufacturing Company, Elizabeth, N. J., has announced a new type of high-speed steel erectors' hoist



BUILDING HOIST WITH AUTOMATIC BRAKES

equipped with automatic emergency brakes. This hoist is built in the 100-hp. size, duty 9,000 lb. at 300 ft. per minute, for operation with three-phase 60-cycle alternating current at 220 volts. It is also available for 440-volt operation on special order.

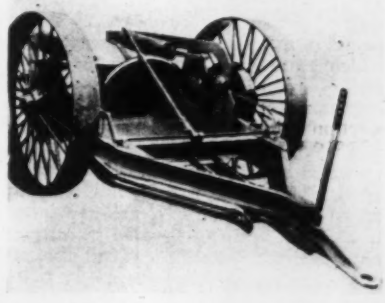
As in older models, the new type of hoist is equipped with band service brakes controlled by foot levers. These are used to govern the rope speed while lowering, or to hold the drums while the frictions are disengaged. In addition, however, emergency-type post brakes are fitted to each drum over the frictions. These are set by springs and released by motor-operated hydraulic rams. When power is cut off the hydraulic operator motor, the piston descends, but is controlled by the dashpot action of oil passing the piston. The more gradual operation of the brake thus obtained tends to prevent cable breakage.

The emergency brakes will act automatically (1) in the event of failure of power supply, either at its source or by the blowing of a fuse; (2) should the leverman fail to keep his feet on the service brake levers, each of which is connected to a switch controlling the emergency brakes for the drum concerned. Furthermore, the emergency brakes may be set at will by means of hand switches for each drum mounted on a convenient panel, which is also provided with pilot lights to indicate whether current is off or on, and whether the brakes are set or not. Although the drums are provided with steel ratchets and pawls, the emergency brakes are used in place of these for regular service. The hoist is also provided with an auto-mechanical non-reversing brake which may be manually released by the operator when he desires to reverse the motor.

Other features are conventional. The drive between motor and hoist is a silent chain belt totally inclosed in an oiltight casing. All gearing is of cut steel, protected by guards. Wiring is inclosed in armored metal conduit, and resistors are of the non-breakable edge wound type. The hoists are shipped from the factory as complete units ready for service except for attaching the current supply wires and fuses, and placing rope on the drums.

Wheeled Scoop Controlled From Tractor

Development of a wheeled scoop with a capacity, level full, of 2 cu.yd., has been announced by the W. A. Riddell Company, Bucyrus, Ohio. This scoop is similar in design to the smaller 1-cu.yd. Warco wheeled scoop. A heavy bowl or pan is supported upon a one-piece, nickel steel axle carrying wheels 66 in. in diameter with 10-in. rims. The axle is arched in the center to afford maximum loading space. The wheels, mounted on Timken bearings, are equipped with housings within which are clutches of the progressive internal expanding band type. The scoop is operated by means of a lever and a latch either by the tractor operator, or, when used in trains, from a loading platform on the leading scoop through hand lines. With the latch in place, a slight pull on the lever hand line actuates the clutch and, by the tractional force of the wheels, causes the bowl to be lowered into cutting or loading position, where it is held by a slight tension on the rope. When this is released, the bowl automatically swings into the raised or carrying position, the front of the bowl being closed by an automatic end gate. To dump, the latch is released and the clutch control lever



WHEELED SCOOP OF 2-CU.YD. CAPACITY

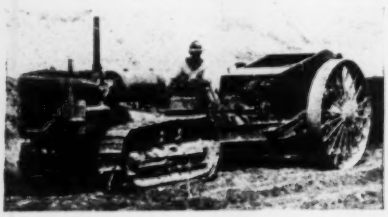
again pulled. This causes the clutch to lift the bowl into dumping position. It is not necessary to stop the tractor either to dump or to load. The scoop bowl is so mounted within a frame supported from the axle that the loading power is taken direct from the tractor drawbar to the bowl cutting lip by means of heavy tubular drawbars.

Special Cable Acts as Switch

Flexible control of any kind of electrical apparatus is made possible by a new type of cable now being marketed by the Bishop Wire & Cable Corporation, Graybar Building, New York City. This consists of a waterproof, dustproof and acid-proof cable about the size of an ordinary lead pencil, which, when compressed at any point in its entire length, closes an electrical connection. Within this cable are two conductors inclosed by the outside insulation and separated from each other by an isolating cushion of rubber. When pressure is applied this cushion yields and permits the outer conductor to contact with the other, thus closing the circuit. When the pressure is relieved the isolating cushion returns the outer conductor to its normal position.

Self-Loading Scraper Operated by One Man

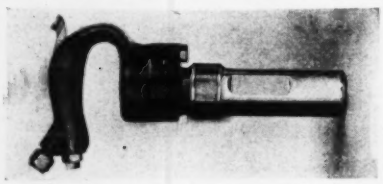
For loading, transporting and dumping earth, gravel and similar material, the Highway Trailer Company, Edgerton, Wis., has developed a rear-dump two-wheel scraper in three sizes, 2, 3½ and 5½ cu.yd., which can be drawn by any make of tractor. The scraper pan is carried on an axle in a channel steel frame supported by two wheels and hooked to the tractor by a drawbar and pin. Power taken from the rear of the tractor is transmitted to the transmission of the scraper by means of a compound universal joint and drive shaft which allows the tractor to turn at an angle of 110 deg. with the scraper and still transmit power. A raking device within the pan is driven by sprockets and chains. This pulls the dirt back from the bit, rising as a load is accumulated. When the pan is full it is upended by means of steel cables winding in sheaves, and can then be transported any desired distance. The dumping door, at the rear, is released by a trip rope, the door leveling the load to any suitable height in passing over. The driver does not leave his seat while these operations are going on. Transmission shafts are equipped with Hyatt and Timken bearings and are lubricated by means of Alemite fittings. Transmission gears run in oil. Chains, digging teeth and all other wearing parts are of manganese steel. If desired, the wheels can be replaced by crawler treads for use in soft ground.



SCRAPER IN TRANSPORTING POSITION

Flapper Valve Used in New Chipping Hammer

Use of a plate valve of the flapper type in a series of chipping hammers introduced by the Ingersoll-Rand Company, New York City, results in shorter over-all length and lighter weight for equivalent capacity. This valve flaps down on its seat in the valve lock to close the airports, and rises to open them, giving quick and full opening and closing. As there is no sliding movement to the valve, it has a smooth and constant action, does not wear, and the fit on the seat improves with use. Other features of the new hammer, which is furnished in five sizes varying from ¾- to 4-in. stroke, include a combination piston and poppet type throttle valve which gives very fine graduation of port opening, open-type handles secured by a new type of pinchbolt arrangement, and an adjustable exhaust deflector flush with the barrel.



NEW TYPE OF CHIPPING HAMMER

Costs and Contracts

E. N.-R. Index Numbers

Cost		Volume	
Dec. 1, 1929	**209.46**	**November, 1929**	**245**
Nov. 1, 1929	208.46	October, 1929	273
Dec. 1, 1928	210.16	November, 1928	251
Average, 1928	206.78	Average, 1928	287
Average, 1927	206.24	Average, 1927	263
1913.....	100.00	1913.....	100

This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of Dec. 19, with some comparisons, total as follows:

(In Thousands of Dollars)

	Dec. 19, 1929	Dec. 12, 1929	Dec. 20, 1928
Buildings:			
Industrial.....	$4,582	$11,726	$5,386
Commercial....	24,410	12,740	30,143
Streets and roads.	5,793	3,370	3,992
Other eng. constr.	14,056	7,645	11,996
Total.....	$48,841	$35,481	$51,517
Total, all classes, Jan. 1 to Dec. 19:			
1929.....			$3,931,578
1928.....			3,523,043

Business Notes

MACARTHUR CONCRETE PILE COMPANY, New York City, has elected new officers as follows: president, Morgan W. Jopling; vice-president, R. E. Sperry; secretary and general manager, R. E. Talmadge.

NATIONAL PORTLAND CEMENT COMPANY OF MISSISSIPPI, Vicksburg, Miss., has appointed L. J. Folse secretary-treasurer. Mr. Folse was formerly general manager of the Mississippi State Board of Development.

BROWN INSTRUMENT COMPANY, Philadelphia, Pa., has appointed E. B. Nichols chief engineer. Mr. Nichols, before joining the Brown organization, had experience with the Pfaudler Company, the Victor Talking Machine Company and the Bell Telephone Laboratories.

FRED D. HOLDSWORTH, engineer in charge of air compressor design for the Sullivan Machinery Company at its plant in Claremont, N. H., from 1900 until his retirement in 1928, died Nov. 20. He was born in Wales, Mass., in 1867, and was graduated from Worcester Polytechnic Institute in 1888. During his lifetime Mr. Holdsworth was awarded more than 50 patents in connection with the development of air compressors.

New Publications

Car Dumpers—LINK-BELT COMPANY, Chicago, Ill., has issued a booklet describing and illustrating the Link-Belt rotary railroad car dumper of the lifting type.

Pumps—ECONOMY PUMPING MACHINERY COMPANY, Chicago, Ill., has compiled three new bulletins describing Economy pumps. These deal with non-clogging sewage ejectors, open-shaft vertical and horizontal non-clogging pumps and split case multistage centrifugal pumps.

Welding—GENERAL ELECTRIC COMPANY, Schenectady, N. Y., is distributing a 12-p. leaflet, "Evidence That Welding Is Being Adopted for Fabricating Steel Bridges and Buildings," by Frank P. McKibben. This contains an up-to-date list of welded structures, including bridges, buildings, ships, tanks and other classifications.

Wall Construction—NATIONAL STEEL FABRIC COMPANY, Pittsburgh, Pa., is distributing a 24-p. illustrated booklet, "Better Walls for Better Homes," describing the methods of application and the results obtained by the use of Steeltex reinforcing for plaster.

Steel Floors—AMERICAN INSTITUTE OF STEEL CONSTRUCTION, INC., New York City, has issued a technical bulletin on battledeck floor construction; steel plates welded to I-beams. This contains a discussion and description of this construction and tables giving allowable loads.

Welded Reinforcing—TRUSCON STEEL COMPANY, Youngstown, Ohio, gives design and estimating data relating to the use of Truscon welded steel fabrics in general construction projects in a newly issued 7-p. pamphlet. Data are given on standard types and sizes, sectional areas, allowable load capacities for floor slabs of various spans, a tentative specification for reinforced-concrete sewer pipe and tables for estimating the weight of welded steel fabric.

Pipe and Conduit—YOUNGSTOWN SHEET & TUBE COMPANY, Youngstown, Ohio, has issued two bulletins giving technical information and data on electrical conduit and on pipes of both the welded and the seamless variety. The first is primarily a descriptive bulletin on conduit; the second is a data book containing many engineering tables on pipe dimensions and weights and similar information, as well as brief descriptions of manufacturing processes and brief directions for the proper handling of pipe on the job to secure satisfactory results.

Steel—BRAITHWAIT & COMPANY, ENGINEERS, LTD., Westminster, England, has published a handsome and well-illustrated 64-p. booklet, "Pressed Steelwork," describing certain products of the company, giving illustrations showing typical installations and containing many engineering tables. Products described include steel flooring, buckle plates, tanks, culvert pipes, shaft and tunnel lining and bridges and structures. The company at present operates two plants in England, two in India and one in South America.